# APPENDIX A

## Pilot Study Report

# VENTILATION AND INDOOR AIR QUALITY IN NEW HOMES

# PILOT STUDY REPORT

Submitted in Response to
California Air Resources Board Research Division
Agreement #04-310

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## Legal Notice

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## INTRODUCTION

This report contains a description of the recruiting, field measurement methods, laboratory analyses, and data analyses used in a three-home pilot study which was recently conducted as part of the research project "Ventilation and Indoor Air Quality in New Homes," which is sponsored by the California Air Resources Board and the California Energy Commission.

This study's primary goal is to obtain information on ventilation characteristics and indoor air quality (IAQ) in new single-family detached homes in California through a field study.

Concerns have been raised regarding whether households in new California homes use windows, doors, exhaust fans, and other mechanical ventilation devices enough to remove indoor air pollutants and excess moisture. Various building materials, heating and cooking appliances, and other products used in new homes can emit substantial amounts of formaldehyde, other toxic air contaminants, combustion pollutants, and/or water vapor. Building practices and building standards for energy efficiency have led to more tightly sealed homes that rely on occupants to open windows for ventilation. However, there is very little information on current ventilation practices, IAQ, or indoor pollutant sources in new California homes.

We plan to study 100 new, single-family homes from two climatic regions of the State, including a subset of 12 homes with mechanical fresh-air ventilation systems. The field teams will measure and record ventilation characteristics, indoor pollutant concentrations, residents' ventilation practices, residents' IAQ perceptions, and residents' decision factors for ventilation and IAQ-related actions. Measurements of indoor and outdoor air quality and ventilation parameters will be made in the summer and winter. Indoor air levels of volatile organic compounds, aldehydes, $PM_{2.5}$, and nitrogen dioxide will be measured over one day. Home ventilation will be determined through tracer gas measurements, building leakage measurements, window use measurement, air flow measurements of fan systems, and occupant diaries. Some homes will have additional measurements, including spring or fall measurements, multiple-day sampling (especially for weekday-weekend differences), and formaldehyde sampling in the attic and heating, ventilating, and air-conditioning (HVAC) systems.

This project has the following specific objectives:

1. Determine how residents use windows, doors, and mechanical ventilation devices, such as exhaust fans and central heating and air-conditioning systems.

2. Measure and characterize indoor air quality (IAQ), ventilation, and the potential sources of indoor pollutants.

3. Determine occupant perceptions of, and satisfaction with, the IAQ in their homes.

4. Examine the relationships among home ventilation characteristics, measured and perceived IAQ, and house and household characteristics.

5. Identify the incentives and barriers that influence people's use of windows, doors, and mechanical ventilation devices for adequate air exchange.

6. Identify the incentives and barriers related to people's purchases and practices that improve IAQ, such as the use of low-emitting building materials and improved air filters.

This study will provide, for the first time, representative, accurate and current information on both ventilation and IAQ in new California homes. IAQ and household ventilation practices will be obtained from multiple seasons and regions of the State, which will help characterize the full range of indoor pollutant exposure in such homes. Measured levels of ventilation and IAQ will be compared to current guidelines and standards. Information on the use of windows, fans, and central systems will help establish realistic values for developing State standards for building energy efficiency.

The Commission will use the study results as a scientific basis to revise the State's building energy efficiency standards in order to provide more healthful, energy-efficient homes in California. The study results will improve ARB's ability to identify current sources of indoor air pollutants, to assess Californians current exposure to measured toxic air contaminants, and to recommend effective strategies for reducing indoor air pollution.

Indoor Environmental Engineering was awarded this project in June 2005 and has completed the preparations of the equipment, protocols, questionnaires, home characteristics checklists, and detailed protocols for the field measurements, data management, and quality control.

This report describes the results of the three-home pilot study that was conducted in November/December 2005. The focus of this report is the presentation and evaluation of the measurement methods and data analyses. Correlations between house characteristics and ventilation and indoor air quality parameters, while not included in this pilot report which contains data from just three homes, will be an important discussion contained in the final report of the 100-home study. Based upon the results of the pilot study presented in this report, feedback from the field teams, the Science Advisory Committee, the ARB, and the Commission will be collected and reviewed to refine the field protocols and data analyses for the main field study.

The main field study is scheduled for the summer of 2006 and the winter of 2007. A final report is expected in late 2007.

## HOME SELECTION/RECRUITMENT

To recruit the three homes for the pilot study we utilized the database from the UC Berkeley Ventilation Practices and Indoor Air quality Survey that was administered in 2004–2005. This mail survey to 4,972 new single family detached homeowners, resulted in 1,448 completed questionnaires (i.e., 31.2% response rate) of which 971 respondents (i.e., 67.1 % of the respondents) indicated their willingness to participate in the second part of the study involving measurements of ventilation and indoor air quality in their homes. In addition to this sample of 971 homeowners we purchased an additional sample of new single-family detached homeowners from the neighboring areas.

From this database we mailed out recruitment letters. This letter asks for the homeowners that are still interested in participating in the field study to call the project participant recruiters at their toll-free number. This letter also offers a $100 incentive to those homeowners that participate in the field study which is in addition to providing the estimated $7,000 of indoor air quality testing free of charge.

Upon making contact with the interested homeowners we administered a recruiting script and collected information on the home, occupancy, and ventilation systems and described the details of the three field visits required by the field teams. In addition, if the homeowners were interested in participating following the description of the three field visits and answering any of their questions, this script collected information regarding the participants preferences for dates and times of the three field visits. In addition, three time periods were offered with the understanding that the same time periods would be required for each of the three field visits. These were:

Time Period 1: 9:00 AM to 12:00 PM
Time Period 2: 1:00 PM to 4:00 PM
Time Period 3: 4:00 PM to 7:00 PM

The homeowners were informed by the recruiters that those that indicated flexibility in the field visit dates and times would have a much higher probability of being selected.

Upon completion of the administration of these recruiting scripts to interested homeowners, we then selected the homes for the field study within the constraints of the field study design, which required one-half of the homes to be in Northern California climate regions, one-half to be in Southern California climate regions, and a minimum of 20 homes to have mechanical outdoor air ventilation.

Also, to minimize the number of outdoor air contaminant measurement locations, and to provide for reasonable logistics, the study design for this research project also required testing clusters of one to three homes (e.g., within the same zip code or within one to two miles).

## FIELD MEASUREMENTS AND METHODS

The following is a description of the field measurements and methods utilized in the three-home pilot study.

## FIELD WORK TEAMS AND WORK ASSIGNMENTS

The field work is divided amongst three field teams, each consisting of two field technicians. All field work will be conducted according to the specific standard operating procedures (SOPs) developed for each of the three field teams. These SOPs are detailed in our October 10, 2005, Quality Assurance / Quality Control Plan (QA/QC Plan).

Field Team 1 will install perfluorocarbon tracer (PFT) sources, data loggers on windows and fans, administer the occupant fan and window logs and the Indoor Contaminant Source Activity Sheet and Occupant Questionnaire one week in advance of the field work performed by Field teams 2 and 3. The SOPs for Field Team 1, along with the associated data entry forms and checklists, can be found in Appendix A of the QA/QC Plan.

Field Team 2 will follow Field Team 1, 7–10 days later to allow for the PFT sources to equilibrate, and install and start the air contaminant sampling equipment at indoor and outdoor locations, install and start the PFT samplers, collect information on home construction characteristics, and inventory indoor air contaminant sources. The SOPs for Field Team 2, along with the associated data entry forms and checklists, can be found in Appendix B of the QA/QC Plan.

Field Team 3 will follow Field Team 2 (22–26 hours later). This field team is responsible for the removal of the air sampling equipment, the PFT samplers, and window/door and fan logs and loggers, and collecting detailed information on building air leakage, duct air leakage, and ventilation system air flow rates. The SOPs for Field Team 3, along with the associated data entry forms and checklists, can be found in Appendix C of the QA/QC Plan.

## HOME AND SITE CHARACTERISTICS COLLECTION

Characteristics of each home were collected using forms that were filled out by the field team members during the home inspections. The forms utilized to record these data are the Home Characteristics Form 1, PFT Form, Home Floor Plan Sketch or floor plan provided by the homeowner, Home Characteristics Form 2, and Room Tally Form, which are in the Team 1 and Team 2 SOPs. A selection of the home characteristics that were recorded have been included in this report based upon their relevance to indoor air quality and ventilation.

General Characteristics

- number of occupants
- number of stories
- foundation type
- conditioned floor area and volume and envelope area
- windows and doors

Mechanical Characteristics

- heating/cooling system - general description, location, filter type, duct locations
- mechanically supplied outdoor air system
- exhaust fans - number and controls
- appliances - fuel type, venting, location
- other ventilation/conditioning equipment - use and typical usage pattern
- air cleaning devices - model number and how used

Site Characteristics

- outdoor air contaminant sources (e.g., busy roadways, nearby gasoline stations, etc.)
- site drainage conditions
- site shielding

Home Contaminant Source Characteristics

- vacuum system - type and typical usage frequency
- number of occupants and pets
- mechanical system fuels
- composite pressed wood
- carpeting
- moisture staining/damage

We calculated the conditioned floor area, envelope area, and air volume from on site dimension measurements. We were able to obtain floor plans from the developers homeowner packages for each of the three pilot homes. Field Team 1 collected on-site measurements of the home exterior dimensions, indoor ceiling heights, and selected indoor wall dimensions. These dimensions were then used to calculate a scale factor for the floor plans, and then this scale factor was used to calculate the conditioned floor areas, envelope areas and air volumes on a room-by-room basis and for the entire home.

## HOMEOWNER SOURCE ACTIVITY

Homeowner activities potentially related to release of contaminants into the indoor air were recorded by the homeowner during the 24-hour IAQ measurement period using a indoor source activity log which was administered by Team 1 and collected by Team 3. The form utilized to record these data is the Home Owner Questionnaire, which is in the Team 1 SOP. The homeowner was asked to record the activity start times, duration, and activity type (e.g., cooking, cleaning, candle burning, dinner parties, barbecuing, leaf blowing, grass cutting) starting at 7:00 PM on the day before the 24-hour IAQ measurements and ending when Team 3 retrieved the forms. This results in up to a 48-hour time period when the homeowner records their source activities, with the first 12–20 hours being practice and the last 28–36 hours being the time period during which the 24-hour IAQ measurements will be collected.

## HOMEOWNER IAQ/VENTILATION PERCEPTIONS AND DECISION FACTORS

Perceptions and decision factors regarding IAQ and ventilation were collected using a questionnaire that was administered to the homeowner by Team 1 and collected by Team 3. The form utilized to record these data is the Home Owner Questionnaire, which is in the Team 1 SOP. The questionnaire was adapted from the one in the UCB mail survey study. This questionnaire collected information regarding the homeowners' perceptions activities that may effect IAQ in the home and key decision factors regarding home ventilation and purchasing ventilating equipment, building materials, air cleaners, and other products and materials that effect IAQ. The requested recall period was three weeks.

VENTILATION MEASUREMENTS

The approach for measuring ventilation applies a combination of one-time tests and weekly monitoring. Collection methods are summarized in this section for the following ventilation parameters:

- windows and doors
- mechanical exhaust fans and appliances
- forced air heating/cooling system
- mechanically supplied outdoor air system
- other ventilation fans
- forced air heating/cooling system duct leakage
- building leakage area
- infiltration parameters

The use of select windows and door and operation of mechanical systems were monitored for an approximate one-week period by occupant logs and/or HOBO data logging instruments. Below are listed the measurement parameter and corresponding type of log device:

| Parameter | Device | Sampling Frequency |
|---|---|---|
| Window/Door Status | HOBO, state logger, two most commonly used. Occupant logs, all that are used. | Event, time recorded |
| Bathroom, Laundry Exhaust Fan Status | HOBO, ac-field logger, up to four most commonly used. Occupant logs, all others. | Event, time recorded |
| Cloths Drier Status | HOBO, vibration or ac-field logger. | Event, time recorded |
| Range Hood Exhaust Fan Status | Occupant log | Event, time recorded |
| HVAC System Fan Status | HOBO, ac-field logger, each furnace | Event, time recorded |
| Outdoor Air Ventilation System Status | HOBO, motor loggers, System fan status, outdoor air damper status, or ventilation system fan status (depending on system type). | Event, time recorded |
| Indoor-Outdoor Temp/RH | HOBO, Temp/RH, 1 Indoor Temp/RH at the thermostat for every home and one outdoor Temp/RH for every ten house regional group. | Quantity, 15 minute intervals |

The following is a description of the methods used to collect data on each of the ventilation parameters.

Occupant Use of Windows and Doors for Ventilation. Homeowners were asked to identify the two most used windows or doors for natural ventilation. HOBO state loggers were taped to these windows (or doors) to capture the time and duration that the window or door was opened. The amount of time that windows were open and the opening areas are reported in 24-hour time periods counting back from the time that Team 3 entered the home and stopped the IAQ contaminant and PFT measurements. The occupants were asked which windows and doors, if any, they use for ventilation. Occupant logs and a writing utensil were placed on the glass or panel near where the window or door was opened The occupants used these to record the time, duration, and distance of the window or door opening. The windows or doors that were verified as never being used were not equipped with window occupant logs. The Window/Door Logs and Instructions Sheets are in the Team 1 SOP.

Measurements of all window and door openings were collected by Team 1. The width and length were noted by opening each window or door and using a tape measure. The forms utilized to record these data are the Window/Door Log Form, which is in the Team 1 SOP.

The location, ID and installation/removal times of all loggers were recorded in the Logger Form, which is in the Team 1 SOP.

Exhaust Fans. Data loggers and/or written logs were deployed for all exhaust fans, including bathroom, laundry, clothes dryer, and kitchen exhaust fans.

For bathroom exhaust fans, two HOBO ac-field loggers were placed above the exhaust grille and just beneath the motors on the two bathroom fans that the occupants identified as used the most**.** For these bathroom exhaust fans with HOBO loggers, no occupant written logs were installed. The reason for this was to minimize the effort required by the homeowners, a concern that was identified during the home practice exercise by the beleaguered homeowner. For any additional bathroom exhaust fans beyond the two exhaust fans equipped with data loggers, occupant logs and a writing utensil were placed near the fan switch for the occupants to log the usage of the fans.

For clothes dryer exhaust fans, our plan was to position the ac-field or electromagnetic field (EMF) HOBO loggers directly on the power cords of the dryer considering electrical dryer fields should be easily captured. Modified extension chords that allowed the HOBO loggers to capture the ac-field by isolating one of the live wires and taping the logger directly on the wire to be used. Due to difficulty experienced during the home practice exercise with compatibility of the modified extension cords with the various outlet/plug configurations for clothes dryers, an alternate method utilizing a vibration HOBO logger installed on the back of the control panel was use for Pilot Homes P1 and P2 and an ac-field logger applied behind the plate of the appliance outlet, inside the outlet box, was used for Pilot Home P3.

For kitchen exhaust fans, our original plan was to utilize a HOBO ac-field logger placed above the exhaust grille and just beneath the motor. However, during the home practice exercise we experienced difficulty in receiving an EMF signal from the exhaust fan motor. Apparently, the fan motors for kitchen exhaust fans are not close enough to the exhaust grille and are shielded by metal partitions to allow for a strong enough EMF signal to be sensed by the loggers. Also, since kitchen exhaust fans typically have multiple fan speeds, and since the HOBO ac-field loggers can only sense operation and not fan speed, our original plans also included installation of an occupant log sheet to log the time, duration, and fan speed associated with the usage of kitchen exhaust fans. Based upon the above experienced difficulties with HOBO ac-field loggers for logging kitchen exhaust fan operation, we decided for the pilot study, and most likely the main field study, to just utilize occupant logs for kitchen fans.

All exhaust fan airflow rates were measured in the home (e.g., bathroom, laundry room, and kitchen hood fans) using a balometer flow hood. Due to difficulty experienced during the practice home exercise accessing an acceptable location to measure the dryer exhaust airflow rate, the flow rate was determined by collecting the dryer make and model information onsite and obtaining the information from the manufacturer. While onsite the number of bends (e.g., 90°, 45°) and the length of the ductwork were estimated. The manufacturers airflow rate and duct characteristics were then used to calculate the actual dryer airflow rate.

The forms utilized to record these data are the Fan Logs and Instruction Sheets, Exhaust / Outdoor Air Fan Log Form, Logger Form, and the Fan Flow Form, which are in the Team 1 and Team 3 SOPs.

Forced Air Heating/Cooling System. HOBO ac-field loggers were used to measure forced air heating/cooling system operation. They were installed magnetically to the end of the furnace blower motor. The access panel to the furnace was removed in all cases to reach the optimum spot on the motor for logging.

Airflow rates were measured at the return grill(s) using a balometer flow hood equipped with a 2 x 4 foot capture hood. One of the homes (i.e., P3) is a single-fan dual-zoned system with two fan speeds. The flow rate for this system was measured with one thermostat in the ”fan-on” position and again with both thermostats in the ”fan-on” position.

The forms utilized to record these data are the Logger Form and the Building Ventilation Form, which are in the Team 1 and Team 3 SOPs.

Mechanically Supplied Outdoor Air Flow Rates. Two types of mechanically supplied outdoor air systems were encountered in the pilot study homes. The two types can be classified as a mechanical exhaust and supply system with a heat/energy recovery ventilator (HRV) system and a night ventilation cooling system. The HRV systems in these homes operate continuously, while the night ventilation cooling systems operate intermittently. Pilot Home P1 had both an HRV and night ventilation system, Pilot Home P2 only had an HRV system, and Pilot Home P3 had no mechanical outdoor air system. The approach used to measure airflow rates for both types of systems was a balometer flow hood. The HRV flow rates were measured at the single outdoor air supply air diffuser as well as at the two exhaust air grilles (e.g., laundry room and master bathroom). The night ventilation cooling system in Pilot Home P1 is integrated with the forced air system. A motorized damper switches the air drawn into the forced air system between home air (i.e., from the central return air grille) and outdoors air (i.e., from an outdoor air intake on the roof).

The ventilation damper for the night ventilation cooling system was monitored using a relay and HOBO state logger combination. We used magnetic tape or a zip-tie to secure the logger with relay to the damper and fastened lead wires with alligator clips to the damper 24 VDC motor wiring connections. The HRVs operate continuously and were not logged with a HOBO logger of occupant log.

The forms utilized to record these data were the Logger Form, Exhaust/Outdoor Air Fan Rate Form, and the Building Ventilation Form, which are in the Team 1 and Team 3 SOPs.

Forced Air Heating/Cooling System Duct Leakage. For the pilot study we used two different methods to measure duct leakage of the forced air system. Testing for both methods was conducted in accordance with ASTM E1554-03, Standard Test Method for Determining External Air Leakage of Air Distribution Systems by Fan Pressurization.

The first method uses a fan flow meter device (e.g., DuctBlaster) attached to the return air grill to pressurize the ducts to 25 pascals (Pa). Figure 4 is a photograph of the DuctBlaster installed at the forced air heating/cooling system return air inlet of home P2. In addition, we conducted three different variations of this duct pressurization method. The first variation, and standard application of this method is to pressurize the ducts to 25 Pa while the supply ducts are sealed. The second variation we employed is to pressurize the ducts to 25 Pa while the house is maintained at a positive 25 Pa by a blower door fan flow meter and the supply ducts are sealed. The third variation we employed is to pressurize the ducts to 25 Pa while the house is maintained at a positive 25 Pa by a blower door fan flow meter and the supply ducts are not sealed.

The second method is the Delta-Q method, which uses a combination of four multipoint home blower door tests (i.e., a home pressurization and depressurization test with the forced air heating/cooling system off and again with the system on).

The form utilized to record these data is the Building Ventilation Form, which is in the Team 3 SOP.

Home Building Envelope Air Leakage Area. The building envelope air leakage area was determined at each house using both depressurization and pressurization multipoint blower door tests with Automated Pressure Testing (APT) instrumentation. Figure 5 is a photograph of the blower door and APT instrumentation installed at pilot home P2. For these tests the homes were configured with all windows and exterior door closed, all interior doors open (except doors to attached garages), fireplace dampers closed, and all exhaust fans off. The continuously operating mechanical outdoor air delivery fans (i.e., the HRVs in Pilot Homes P1 and P2) were left operating. Testing was conducted in accordance with

ASTM E779-99, Standard Test Method for Determining Air Leakage by Fan Pressurization. The form utilized to record these data is the Building Ventilation Form, which is in the Team 3 SOP.

Home-to-Garage Air Leakage. We used two methods for measuring the potential air leakage between the home and the garage. The first method consisted of conducting a zone pressure diagnostic test of the garage to home connection. This test consist of conducting two multi-point blower door home depressurization tests as described above; one with the home door to the garage closed and one with the door open. From these data we calculated the Equivalent Leakage Area (EqLA @ 10 pa) in square inches between the garage and the home and between the garage and outdoor. The second test method consisted of using a blower door with the Automated Pressure Testing (APT) instrumentation operating in "cruise control" to maintain a constant –50 Pa in the home with respect to outdoors. A digital micro-manometer was used then used to measure the differential pressure between the home and the garage.

Tracer Gas Measurements of Home Outdoor Air Exchange Rate. The outdoor air exchange rate in the homes was measured with a tracer gas technique during the 24-hour air contaminant measurements and during a subsequent two-week period. This technique uses a passive constant injection perfluorocarbon tracer (PFT). The tracer gas sources were placed by Field Team 1 at locations in each home for approximately one week in advance of the tracer gas sampling to allow for the emission rates of the sources to equilibrate. The number of sources and placement locations were determined for each home based on room volumes and layout to approximate a uniform indoor concentration. Since the emission rates from the PFT sources are temperature dependent, we deployed a HOBO air temperature data logger, located at the heating/cooling system thermostat, to log the air temperature at 15-minute intervals. This temperature data was then input into an equation of the emission rate as a function of time that was supplied by Brookhaven National Laboratory, the supplier of the PFT sources, to calculate the temperature corrected PFT emission rates. The PFT used for these tests was para-methylcyclohexane (p-PMCH). The PFT samplers used for these tests were capillary adsorption tube sampler (CATS). These are small passive samplers that were co-located at the indoor air contaminant site (e.g., family/living room). A pair of these samplers, along with duplicate samplers, were deployed for the 24-hour and two-week samplers by Field Team 2. The outdoor air exchange rate was calculated as described in ASTM E741.

A deviation from the above measurement plan that we needed to make related to the two-week long-term PFT measurements. Since the blower door measurements conducted by Team 3 the day after the deployment of the PFT samplers would have a significant and atypical impact on the home ventilation rate, we decided to cap the long-term PFT samplers when we shut down the indoor air sampler and capped the short-term PFT samplers before the blower door tests. We then asked the homeowners if they would uncap the long-term PFT sampler 48 hours later. We called each of the homeowners to confirm that the samplers were uncapped and then Field Team three collected the long-term PFT samplers from the pilot homes on a second visit to each house approximately two weeks later.

The form utilized to record these data is the PFT Form, which is in the Team 1 SOP.

<u>Tracer Gas Measurements of Garage Air Contaminants Entering the Home</u>. The transport of garage air contaminants into the indoor air of the home was measured with a tracer gas technique during the 24-hour air contaminant measurements and during a subsequent two-week period. This technique uses a passive constant injection perfluorocarbon tracer (PFT). The tracer gas sources were placed by Field Team 1 at a location in the garage, approximately one week in advance of the tracer gas sampling to allow for the emission rates of the sources to equilibrate. A total of two sources were placed at a central location in the garage. Since the emission rates from the PFT sources are temperature dependent, we deployed a HOBO air temperature data logger, co-located with the two PFT sources, to log the air temperature at 15-minute intervals. These temperature data were then input into an equation of the emission rate as a function of time that was supplied by Brookhaven National Laboratory, the supplier of the PFT sources, to calculate the temperature corrected PFT emission rates. The PFT used for these tests, para-dimethylcyclohexane (p-PDCH), was a different PFT than was used to measure the outdoor air exchange rate of the home. The same PFT samplers that were used to measure the outdoor air exchange rate of the home were used to sample the garage-located PFT entering the home. The form utilized to record these data is the PFT Form, which is in the Team 1 SOP.

The percent of the garage air contaminant sources entering the home was determined from the ratio of the calculated source of garage PFT entering the home to the calculated source of garage PFT emitted into the garage. The emission rate of garage PFT entering the home was calculated from the average concentration of the PFT in the home, which was determined from the laboratory analysis of the indoor

PFT sampler multiplied by the outdoor air flow rate entering the home, which was determined from the tracer gas measurements of the outdoor air exchange rate and the indoor air volume of the home. For the emission rate of garage PFT into the garage, we used the temperature corrected calculation of the garage PFT emission rates.

## INDOOR AIR QUALITY MEASUREMENTS

The following is a summary of the indoor air quality parameters that were measured in each home:

Integrated Time Averaged IAQ Measurements

- Volatile Organic Compounds (VOCs)
- Formaldehyde and Acetaldehyde
- Nitrogen Dioxide
- Particles ($PM_{2.5}$)

Real-Time IAQ Measurements

- Carbon Monoxide
- Carbon Dioxide
- Temperature and Humidity

These IAQ parameters were measured for 22- to 26-hour period at one indoor breathing height location in the family/living room area of each of the three pilot study homes. In addition, these IAQ parameters were also measured over the same time period at an outdoor location. For pilot homes P1 and P2, which represented a sampler cluster of two homes located less than 0.1 miles apart in Elk Grove, California, IAQ parameters were collected at a single outdoor location in the backyard of P1. For pilot home P3, which was located in Sacramento, California, IAQ parameters were collected at a single outdoor location in the backyard of P3. Duplicate air samples were collected at the P1 home at the indoor location. Integrated sample flow rates were measured at the beginning and end of the sampling period using calibrated rotameters.

A special air sampler was developed to collect the integrated and real-time air contaminant concentrations. Figure 1 is a photograph of the air sampler located at the P3 indoor site and Figure 2 is close-up photograph of the air sampler. For the integrated air samples, this air sampler consisted of a pair of air sampling pumps contained in an acoustically shielded fiberglass lock box mounted to a tripod. The air sampling pumps are SKC AirCheck 2000 air sampling pumps that include an internal flow sensor that provides automatic electronic air flow control such that the sample airflow rate is maintained to within ± 5%, and 115 VAC battery eliminators to allow operation over the proposed 24-hour sampling periods. One of these pumps provides the air sampling flow rate for the $PM_{2.5}$ measurement. The second pump, through the use of a four-port manifold with low flow control valves, provides the air sampling flow rate for the volatile organic compounds, nitrogen dioxide, and formaldehyde/acetaldehyde measurements. An power on-time meter provides a measurement of the time that 110 VAC power is supplied to the air sampler so that if there is a power interruption the duration of the interruption is known. The air sampling pumps automatically restart upon restoration of the power following a power interruption. In addition, a power cord restraint cover is installed at the connection of the power cord to the power receptacle to guard against inadvertent disconnection of the power cord plug from the receptacle. For the real-time measurements, a TSI IAQ-Calc is mounted on the tripod next to the integrated air sampler manifold. The AC adaptor for the TSI IAQ-Calc is connected to a source of AC power inside of the fiberglass lock box. In addition, the TSI IAQ-Calc contains a parallel battery pack power supply that allows the instrument to continue operation upon a power interruption. For the outdoor air sampler a special rain/radiation shield was fabricated from galvanized sheet metal to enclose and protect the air samplers. This rain/radiation shield has screened and louvered vents on two sides to allow circulation of outdoor air within the enclosed area. Figure 3 is a photograph of the air sampler with the rain/radiation shield installed.

The following is a detailed description of the air sampling and analytical techniques for each of the IAQ parameters.

<u>Integrated Time Averaged IAQ Measurements (24-hour)</u>

• Volatile Organic Compounds. Volatile organic compounds other than formaldehyde and acetaldehyde were measured following U.S. EPA Methods TO-1, TO-15, and TO-17 from the Compendium of

Methods for the Determination of Toxic Organic Compounds in Ambient Air (EPA 1999). This method involves drawing air at a constant rate with a pump through a multi-sorbent tube (i.e., Berkeley Analytical Associates sorbent tubes containing Tenax-TA® backed up with a carbonaceous material to prevent breakthrough of the most volatile compounds). Samples were collected at a flow rate of approximately 10 cubic centimeters per minute (cc/min), which will provide a detection limit of 0.4 micrograms per cubic meter ($\mu g/m^3$) for most compounds. The samples were split 1:5 to prevent overloading of the analytical instrumentation and thermally desorbed and analyzed by gas chromatograph/mass spectrometry. For the pilot study, indoor and outdoor samples were be fully analyzed to identify all of the compounds detected above 4 $\mu g/m^3$ and to quantify abundant air contaminant compounds that appear on the Toxic Air Contaminant List (CARB 1999), the California Proposition 65 Substance List and the Chronic Reference Exposure List (OEHHA 2003), and any other compounds that were detected with concentrations above 3 $\mu g/m^3$. Laboratory results for each sampler were corrected using a field blank, which was submitted to the lab.

• Formaldehyde and Acetaldehyde. Formaldehyde and acetaldehyde was measured according to ASTM Standard D 5197-03 (ASTM 2003). This method involves drawing air at a constant rate with a pump through a solid sorbent cartridge (i.e., Waters Associates Sep-PAK, silica gel impregnated with dinitrophenylhydrazine, DNPH). In addition, since ozone is known to interfere with this sample analyses, an ozone scrubber was installed directly upstream of the solid sorbent cartridge. This scrubber consists of a solid sorbent cartridge filled with granular potassium iodide (i.e., Waters Associates Sep-PAK Ozone Scrubber). Additionally a scrubber (i.e., Anasorb CSC, coconut charcoal sorbent tube) for DNPH was placed downstream of the sampler because this compound would be collected and analyzed for in the VOC sampling protocol. The samplers are extracted with acetonitrile and analyzed using HPLC. Samples were collected at a flow rate of approximately 70 cc/min, which will provide a detection limit of 0.4 $\mu g/m^3$ for acetaldehyde and 0.3 $\mu g/m^3$ for formaldehyde. This concentration detection limit is well below both the California Environmental Protection Agency/Office of Environmental Health Hazard Assessment (Cal/EPA OEHHA) chronic inhalation Reference Exposure Levels (OEHHA 2003) of 3 $\mu g/m^3$ and 9 $\mu g/m^3$ for formaldehyde and acetaldehyde, respectively, as well as the ARB Indoor Air Quality Guidelines (California Air Resources Board 2004) of 33 $\mu g/m^3$ for formaldehyde for an 8-hour exposure. Laboratory results for each sampler were corrected using a field blank which was submitted to the lab.

• Nitrogen Dioxide. Nitrogen dioxide was measured following NIOSH 6014 (NIOSH 1994a). This method involves drawing air at a constant rate with a pump through a two stage solid sorbent tube (i.e., SKC 226-40-02 molecular sieve impregnated with triethanolamine). The samplers were extracted with a triethanolamine solution and analyzed using spectrophotometry at a wavelength of 540 nanometers (nm). Both the front tube section and backup tube section were be separately analyzed to verify that there was no significant breakthrough. Samples were collected at a flow rate of approximately 100 cc/min, which will provide a detection limit of 9 $\mu g/m^3$. This concentration detection limit is well below both the U.S. Environmental Protection Agency (EPA) National Ambient Air Quality Standard (NAAQS) (EPA 1990) standard of 100 $\mu g/m^3$ for an annual exposure, as well as the ARB Indoor Air Quality Guidelines (California Air Resources Board 2004) of 150 $\mu g/m^3$ for a 24-hour exposure. Laboratory results for each sampler were corrected using a field blank, which was submitted to the lab.

• Particulate Matter ($PM_{2.5}$). $PM_{2.5}$ particles were collected following EPA IP-10A, (EPA 1989) with gravimetric analyses according to NIOSH 500 (NIOSH 1994b). This method involves drawing air at a constant rate with a pump through a $PM_{2.5}$-size selective inlet (i.e., SKC 761-203 Personal Environmental Monitor) containing a 37 millimeter (mm) PVC filter with a 0.8 micron (µm) pore size. After sampling, the filters were equilibrated in a climate controlled weighing room and analyzed gravimetrically. Samples were collected at a flow rate of 2 liters per minute (L/min) which represents the design flow rate of this impactor and which will provide a detection limit of 3.5 $\mu g/m^3$. This concentration detection limit is well below both the EPA NAAQS (EPA 1990) ambient air quality standard and the ARB Indoor Air Quality Guidelines (California Air Resources Board 2004) of 65 $\mu g/m^3$ for 24-hour exposures. Laboratory results for each sampler were corrected using a field blank, which was submitted to the lab.

<u>Real-Time IAQ Measurements</u>

• Carbon Monoxide. Carbon monoxide was measured with real-time instrumentation following EPA method IP-3A (EPA 1989) using an electrochemical sensor. A TSI IAQ-Calc, which incorporates a passive diffusive sample element and has built in data-logging capabilities was used. The data logger was programmed to record carbon monoxide concentrations at one-minute intervals. The sensor has an accuracy of ± 3% or ± 3 parts per million (ppm), whichever is greater, a precision of ± 2% of reading, a resolution of 1 ppm, and a range of 0–500 ppm. This concentration detection limit is well below both the EPA NAAQS (EPA 1990) and the ARB Indoor Air Quality Guidelines (California Air Resources Board 2004) of 9 ppm for 8-hour exposures. The instrument was calibrated immediately prior to the start of sampling and checked following the sampling period, using zero and span (35 ppm) calibration gases. The sample data logged over the 24-hour period was corrected using a fit to the calibration points that was assumed to be linear over time.

• Carbon Dioxide. Carbon dioxide was measured with real-time instrumentation following EPA method IP-3A (EPA 1989) using a sensor that utilizes non-dispersive infrared spectrophotometry (NDIR). A TSI Q-Trak, which incorporates a passive diffusive sample element and has built in data-logging capabilities was used. The data logger was programmed to record carbon dioxide concentrations at one-minute intervals. The sensor has an accuracy of ± 3% or ± 50 ppm, whichever is greater, a resolution of 1 ppm, and a range of 0–5000 ppm. This concentration detection limit is well below both the ASHRAE (ASHRAE 2004) body odor standard of 700 ppm over the outdoor concentration, which for typical outdoor concentrations of 350 to 450 ppm represents an indoor concentration of 1,050 to 1,150 ppm. The instrument was calibrated immediately prior to the start of sampling and checked following the sampling period, using zero and span (1000 ppm) calibration gases. The sample data logged over the 24-hour period was corrected using a fit to the calibration points that was assumed to be linear over time.

• Temperature and Relative Humidity. Temperature and relative humidity were measured with real-time instrumentation using a thermistor sensor for air temperature and a thin-film capacitive sensor for relative humidity. A TSI IAQ-Calc with built-in data logging capabilities was used. The data logger was programmed to record temperature and relative humidity at one-minute intervals. The temperature sensor has an accuracy of 1°F, a resolution of 0.1°F, and a range of 32°F–122°F. Prior to the field effort, the instruments' temperature sensors were compared to a certified mercury thermometer, and the sample data logged over the 24-hour period was corrected using single point correction. The relative humidity (RH) sensor has an accuracy of 3 % RH, a resolution of 0.1 %RH, and a range of 5%–95% RH. Prior to the field effort, the instruments' relative humidity sensors were compared with a laboratory probe that was calibrated with salt solutions according to ASTM E104-02 (ASTM 2002). The sample data points logged over the 24-hour period were corrected using a single point correction.

We obtained meteorological data from the Sacramento Mather Airport weather station for the period of the pilot study. We obtained hourly wind speed and outdoor air dry bulb temperature. The airport is 12 miles northeast from the Elk Grove site for P1 and P2 and 15 miles southeast from the Sacramento site for P3.

## QUALITY ASSURANCE AND QUALITY CONTROL

For this pilot study of three homes we followed our October 10, 2005, Quality Assurance / Quality Control Plan (QA/QC Plan). For each of the integrated air contaminant measurements, VOCs, $NO_2$, formaldehyde/acetaldehyde, and $PM_{2.5}$, we collected and analyzed a single field blank and a single duplicate, with the exception for $PM_{2.5}$, for which we collected four field blanks. For the PFT measurements we collected and analyzed a single field blank and two 24-hour duplicate samples and one two-week duplicate sample. As per our QA/QC plan, the PFT sources and PFT samplers were stored and shipped separately.

We also evaluated the air sampling flow rate stabilities by comparing the rotameter measurements of the air sampling flow rates at the beginning and end of the 24-hour air sampling period for each of the integrated air samples. We calculated the relative standard deviation for each of the beginning and end pairs of flow rate measurements.

## DATA MANAGEMENT

For this pilot study we created in Excel all of the field data sheets contained in the SOPs that are detailed in our October 10, 2005, Quality Assurance / Quality Control Plan (QA/QC Plan). Hard copies of these field data sheets were taken into the field and used to record the data. The data on these hard copy field data sheets were then entered into identical electronic copy field data sheets. These Excel sheets contain all of the calibrations and calculations for converting the collected field data into the various ventilation and indoor air quality parameters.

## RESULTS AND DISCUSSION

### HOME SELECTION/RECRUITMENT

We mailed a total 64 recruitment letters to new single-family homes to each of the addresses in the Sacramento and Elk Grove communities that were in the University of California (UC) Berkeley database. A total of two letters were returned with notes of “no such name” suggesting the original homeowner had moved. During the next two weeks we received a total of seven responses for an 11% response rate from the mailing. The following are the results of the follow-up call to these seven respondents:

• 2 were interested, but not qualified because they were moving soon.
• 5 were interested in participating in the pilot study.

As indicated in the Methods section there were no phone numbers contained in the UC Berkeley database. We went to the library and looked up phone numbers for the 57 homes that did not respond, and we were able to find 25 phone numbers with a name or address match (a 44% find rate). We attempted a minimum of three calls to each number. The following are the results of the follow-up call to these 25 phone calls:

• 12 were left messages that newer returned the call
• 4 were bad phone numbers
• 4 were interested in participating in the pilot study
• 3 were not interested (one with an infant)
• 1 was interested, but not qualified because they were moving soon
• 1 was interested but at a later date

Thus the mailing to 64 homes netted 5 interested pilot study participants, and the 25 phone calls netted an additional 4, for a total of 9 homes.

We then established clusters for those homes based on their relative clusters and based upon which of the two sets of measurement dates and three inspection times each of the homes noted as being required or preferred. From these potential clusters we then looked for two clusters that satisfied the requirements of having one home with mechanical outdoor air ventilation and having homes from two different developments.

For this pilot study of three homes we selected a two-home cluster in Elk Grove and a one-home cluster in Sacramento. The two homes we selected from Elk Grove are in the same development and are approximately 0.1 miles apart. They are both single-story wood frame structures with a slab-on-grade foundation and attached garages. The both have forced air ventilation systems installed in the attic, and they both have a separate dedicated outdoor air heat recovery ventilator systems (HRV), also installed in the attic. We selected a single home from Sacramento. This home is a two-story wood frame structure with a slab-on-grade foundation and an attached garage, and it has a forced air ventilation system installed in the attic and no mechanical outdoor air system.

Figures 6–8 are photographs of the three pilot homes, and Figures 9–12 are floor plans.

## HOME AND SITE CHARACTERISTICS COLLECTION

Table 1 summarizes the characteristics of each of the three pilot homes, including general characteristics, contaminant source characteristics, and ventilation and air cleaning characteristics. These are average-sized homes with low occupancies. During the field study the occupancy of pilot home P3 increased from two to three with birth of a daughter. Table 2 is a summary of the homeowner reported home renovations, maintenance, and other IAQ related activities. Table 3 is a summary of the homeowner-reported building system failures and home IAQ improvements. Home P2 had a reported plumbing leak, and homes P1 and P2 noted the installation of upgraded filters (these filters turned out to have a lower efficiency than typical residential furnace filters).

HOMEOWNER SOURCE ACTIVITY LOG

Table 4 summarizes the indoor source activities reported by the homeowners for the 24-hour period during which the indoor air contaminant measurements occurred. As can be seen, there was little source activity occurring in these three homes. Homes P1 and P2 have retired occupants who apparently eat out a lot. Home P3, had some cooking activity, but this was also not much, perhaps because the mother was about to give birth.

HOMEOWNER IAQ/VENTILATION PERCEPTIONS AND DECISION FACTORS

Table 5 summarizes the homeowner reported perceptions and physical symptoms over a three-week recall period. P2 reported environmental conditions “too drafty” and “too dusty,” and P3 reported “too cold.” P1 reported odors from cabinetry. P1, whose occupants have diagnosed allergies and asthma, reported the following physical symptoms: nose/sinus congestion, allergy symptoms, and headache. P2, whose occupants have no diagnosed allergy or asthma conditions, reported allergy symptoms.

VENTILATION MEASUREMENTS

The following is a description of the results of our ventilation measurements in the three pilot homes.

<u>Occupant Use of Windows and Doors for Ventilation</u>. Table 6 summarizes for each of the three pilot study homes, one week of daily openings and closings of doors expressed as square foot-hours ($ft^2$-hrs). As can be seen from these data, P1 and P2 hardly used their windows or doors at all—they were all 0 except 0.1 $ft^2$-hr for P2 on Day 7 ( i.e., the air sampling day). P3 had window usage ranging from 0 to 163 $ft^2$-hr with 51 $ft^2$-hr on Day 7 ( i.e., the air sampling day). For the two windows in each home with dataloggers monitoring the openings and closings, we compared the data logger records of window openings and the occupant written logs. In P1 the occupants logged 0 of 1 opening events. In P2 the occupants logged 0 of 3 opening events. In P3 the occupants logged 1 of 3 opening events. Thus the accuracy of the occupant logs does not appear to be very good.

Exhaust Fans and Appliances. The exhaust air flow rates and associated building guidelines and codes are summarized in Table 7. P1 and P2 have continuous exhaust air from the master bathroom and laundry room that is associated with the HRV systems in these two homes. All other bathroom and laundry room exhaust fans operate intermittently with a user-controlled wall switch.

For the 4 bathrooms with continuous exhaust ventilation from the HRVs, all 4 exceeded the minimum ASHRAE 62.2-2003 guideline of 20 cubic feet per minute (cfm).

For the 9 bathrooms with intermittent exhaust ventilation, 7 of the 9 failed the minimum ASHRAE 62.2-2003 guideline of 50 cfm.

For the 13 bathrooms with continuous or intermittent exhaust ventilation, 6 of the 13 failed the minimum California Building Code 2001 requirement of 5 air changes per hour (ach).

For the 6 bathrooms with openable windows, 1of 6 failed the minimum California Building Code 2001 requirement of an openable area equal to 5% of the floor area for bathrooms and 4% of the floor area for toilet rooms. The one bathroom with window openings less than the guideline also had mechanical exhaust systems, which were also under one or more of the recommended guidelines.

For the 6 bathrooms with openable windows, all 6 met the minimum California Building Code 2001 requirement of an openable area equal to 1.5 $ft^2$.

Overall, 7 of the 13 bathrooms either met the openable window or mechanical exhaust requirements; 3 of 4 in P1 and P2, and 1 of 5 in P3.

Table 8 summarizes the kitchen exhaust air flow rate measurements. All three pilot homes had intermittent kitchen exhaust fan systems that were ducted to outdoor and met the ASHRAE 62.2. guideline of 100 cfm.

Table 9 summarizes all of the exhaust fan operation in each home for a seven-day period. Day seven is the 24-hour test period during which the outdoor air exchange rate and indoor air quality parameters were measured. The daily operation time for each of the fans as determined from the HOBO data loggers and/or written occupant logs was multiplied by the measured air flow rates to produce the cfm-hours of operation for each fan systems. Pilot homes P1 and P2 have exhaust air operations dominated by the continuously operating HRVs.

For the other intermittent exhaust fans, averaged over the one-week monitoring period, the exhaust ventilation was dominated by the clothes drier exhaust ( 88%–221% of 252 cfm) in P1, by the clothes drier in P2 ( 75%–80% of 107 cfm), and by the kitchen (50%–48% of 97 cfm) and the master bathroom toilet exhaust (40%–40% of 97 cfm) in P3.

Forced Air Heating/Cooling System. The return air flow rates and percent on-times for the forced air heating/cooling systems are summarized in Table 10. The percent on-times for the forced air heating/cooling systems during the one-week period of monitoring ranged from 7%–20% in P1, and 0% in P2, and 2%–23% in P3. We examined the indoor air temperature data for P1 and while the data logger indicated no operation during the week, the air temperatures suggested that there was some heating. In addition, the data logger appeared to be working, as it registered the operation of the forced air heating/cooling systems during the time that Field Team 3 operated the system to measure the system air flow rate.

Mechanically Supplied Outdoor Air Flow Rates. Table 11 contains the measurements of the mechanical outdoor air ventilation rates in pilot homes P1 and P2, which both had continuously operating HRVs. In P2, the measured flowrates of outdoor air exceeded the recommendations of both ASHRAE 62.2. and the Energy Commission in P2, but in P1 the measured flow rates, while exceeding the ASHRAE 62.2. guideline, were below the Energy Commission guideline.

Forced Air Heating/Cooling System Duct Leakage. We note that we were not able to measure the duct leakage in P3 as a result of the homeowners request to end the testing because of noise/disruption to a new baby. Table 12 contains the duct pressurization measurements of air leakage for homes P1 and P2. These tests were conducted with three different configurations, as discussed in the methods section. The standard duct leakage method of pressurizing the ducts to 25 Pa while the supply ducts are sealed resulted in 4.9% air leakage for both homes P1 and P2. This air leakage was reduced to 4.6% in P1 and

3.0% in P2, when the house was pressurized to 25 Pa with the supply air registers still sealed. This air leakage was further reduced to 2.5% in P1 and 0.2% in P2 when the house was pressurized to 25 Pa with the supply air registers unsealed.

The results of the Delta-Q test method are summarized in Table 13. The supply air leakage and return air leakage were 61 cfm and 42 cfm, respectively, for P1, and they were 20 cfm and 43 cfm, respectively, for P2. We note that the estimated measurement uncertainty is ± 20 cfm for this measurement method.

Table 14 summarizes the of the home indoor differential pressure with respect to outdoors with the forced air heating/cooling system fan on and off. In the California Energy Commission, Title 24, 2001 Residential ACM approval Manual, if the Standard Leakage Area is less than 1.5 mechanically supplied outdoor air is required and the home differential air pressure with respect to outdoors must be maintained greater than -5 Pa with all continuous ventilation fans operating. Both P1 and P2 had differential pressures greater than –5 Pa. In addition there was no significant difference between differential pressures with the furnace fan on or off.

<u>Home Building Envelope Air Leakage Area</u>. The building envelope leakage area measurements of the three homes are summarized in Table 15. We note that we were only able to measure the building air leakage area with depressurization in P3 as a result of the homeowners request to end the testing because of noise/disruption to a new baby. The ACH50 from the depressurization measurements were 4.31 ach in P1, 6.26 ach in P2, and 3.97 ach in P3. The specific leakage area (SLA), as defined by the California Energy Commission, Title 24, 2001 Residential ACM Approval Manual, with depressurization ranged from 2.74 in P1, 3.97 in P2, and 2.05 in P3. Thus, both P1 and P3 have SLAs less than 3.0 and greater than 1.5, and thus are required to have a mechanical supply of outdoor air of no less than 0.047 cfm/ft$^2$. In Table 11, our calculations indicate that in P1 the measured outdoor air flow rates, while exceeding the ASHRAE 62.2 guideline, were below the Energy Commission guideline. There was no mechanical outdoor air delivery system in P3.

<u>House-to-Garage Air Leakage</u>. The results of the zone pressure diagnostics of the garage to home connection are summarized in Table 16. We note that all three homes had self-closing and weather-stripped doors to the garages. The house-to-garage leakage areas (EqLA – 10 Pa, inches$^2$) ranged from

4 square inches ($in^2$) in P3 to 8.5 $in^2$ in P2 to 20 $in^2$ in P3. There are no guidelines for garage-to-house air leakage areas; however, as a perhaps more meaningful metric with respect to potential contamination of the house air with garage air, we have calculated the percentage of the house-to-garage leakage to the total leakage area of the house-to-outdoor and the garage-to-outdoor. This percentage ranged from 1% in P1 to 2% in P2 to 3% in P3. We also measured the house-to-garage pressure with the house-to-outdoor air pressure held at 50 Pa. The garage pressures ranged from –049.8 Pa for P3 to –49.4 Pa for P1 to –49.4 Pa for P3. These house-to-garage pressures are all meet the American Lung Association (ALA) guideline of a minimum of –49 Pa.

<u>Tracer Gas Measurements of Home Outdoor Air Exchange Rate</u>. The results of the tracer gas measurements of outdoor air exchange rates are summarized in Table 17. The locations of the PFT sources and samplers are depicted in Figures 9–12. The 24-hour measurements ranged from 0.26 ach in P3 to 0.37 (0.37 ach duplicate) ach in P1 to 0.73 ach (0.71 ach duplicate) in P2. The long-term two week samples resulted in 0.29 ach in P1, 0.57 ach in P2, and 0.30 (0.34 ach duplicate) in P3.

These air exchange rates may be compared to the ASHRAE 62-1989 and the Energy Commission ACM recommendations of 0.35 air changes per hour.

<u>Tracer Gas Measurements of Garage Air Contaminants Entering the Home</u>. The results of the measurement of garage source emissions entering the house are summarized in Table 18. The locations of the PFT sources and samplers are depicted in Figures 9–12. For the 24-hour measurement period the percentage of the garage sources entering the home ranged from 2.6% (1.9% duplicate) for P1 to 9.8% for P3 to 10.1% (11.9% duplicate) for P2. For the two-week measurement period, the percentage of the garage sources entering the home ranged from 4.0% for P1 to 7.2% for P2 to 11.3% (11.4% duplicate) for P3.

<u>Ventilation Calculations</u>. In Table 19 we calculate the combined outdoor air exchange rate resulting from the natural infiltration rate and the mechanical ventilation rates and compare this calculated total rate to the PFT measurements of the outdoor air exchange rate. We have used to models to calculate the combination of the natural and mechanical outdoor air ventilation rates. The first calculation is according to ASHRAE 136, which calculates the total outdoor airflow rate as the square root of the sum

of the squares of the natural and mechanical airflow rates. The second calculation is according to the Palmiter/Bond 0.5 Rule, which calculates the total outdoor air flow rate as either (1) the sum of the balanced mechanical flowrates, the natural infiltration rate, and one-half the unbalanced mechanical flow rates if the unbalanced mechanical air flow rates are less than twice the natural infiltration air flow rates, or (2) if the unbalanced mechanical air flow rates are greater than twice the natural infiltration air flow rates, as the maximum of the total mechanical exhaust or total mechanical outdoor air flowrates. We note that neither of these models nor any other simple models can incorporate the outdoor air exchange rate resulting from openable windows and doors. In addition, we note that these calculations were performed using 24-hour averages for the exhaust and outdoor air mechanical flow rates and because of the non-linearities in combining mechanical air flow rates and air flow rates through the building envelope, a more accurate calculation is to perform the calculations using hourly averaged data. We note that an hourly calculation, while beyond the scope and resources of this study, could be done as there is hourly data available for all of the parameters.

The calculated outdoor air exchange rates from the ASHRAE 136 and Palmiter/Bond, respectively, ranged from 0.35 ach / 0.36 ach for P1 to 0.66 ach / 0.66 ach for P2 to 0.12 ach / 0.12 ach in P3 using the P2 Delta-Q duct leakage data and to 0.10 ach / 0.11 ach in P3 assuming no duct leakage.

These calculations of total outdoor air exchange rates for the 24-hour measurement period agree reasonable well with the PFT measurements for P1 and P2, which both had continuous mechanical outdoor air ventilation and none to little reported use of openable windows and doors. The calculated outdoor air exchange rate for P3, 0.10–0.12 ach, was less than half of the measured value of 0.26 ach. Part of this discrepancy may be the result of the use of openable windows and doors to ventilate this residence, as there were a total of 50.8 $ft^2$-hrs of openings in P3.

## INDOOR AIR QUALITY MEASUREMENTS

The locations of the indoor and outdoor air samplers are depicted in Figures 9–12.

Integrated Time-Averaged IAQ Measurements (24-hour)

• Volatile Organic Compounds. The indoor and outdoor concentrations of volatile organic compounds are summarized along with recommended indoor guidelines in Tables 20–23. The first basis for our selection of non-industrial irritant guidelines is the California Air Resources Board, Indoor Air Pollution in California, Table 4.1 ARB Indoor Air Quality Guidelines, July 2005 (CARB 2005). Our second basis for selection, for those compounds without ARB indoor air guidelines is the California Office of Environmental Health Hazard Assessment Chronic Reference Exposure Guidelines (OEHHA CRELs). Our final basis of selection, for those compounds, with neither ARB indoor guidelines or OEHHA CRELs, is 2.5% of the occupational standard. This recommendation is based upon the different exposure periods (40-hour per week for an industrial worker versus a 168-hour per week for a full-time occupant) and to provide a safety factor of ten for more sensitive populations (Nielsen et al. 1997).

The percent of the indoor guideline for the maximum indoor concentrations observed in the three pilot homes ranged from 9.3% for toluene in P1 and P2 to 6.3% for benzene in P1 to 3.5% for ethylene glycol in P1 to 2.5% for ethanol in P1 to 2.1% for propanol in P1. All other compounds were less than 2% of the indoor guidelines.

• Formaldehyde and Acetaldehyde. The indoor and outdoor concentrations of formaldehyde and acetaldehyde are summarized along with recommended indoor guidelines in Table 24. For formaldehyde we utilized the 33 $\mu g/m^3$ guideline recommended by the ARB (CARB 2005). For acetaldehyde we utilized the Chronic Reference Exposure Guidelines of 9 $\mu g/m^3$ recommended by OEHHA (OEHHA 2003).

For formaldehyde, homes P1 and P2 were below the recommended guideline of 33 $\mu g/m^3$, however P3, with a concentration of 45 $\mu g/m^3$ was above this guideline.

For acetaldehyde, home P2 was below the recommended guideline of 9 $\mu g/m^3$, however homes P1 and P3, with indoor concentrations of 10 $\mu g/m^3$ (11 $\mu g/m^3$ duplicate) an 17 $\mu g/m^3$, respectively, were above this guideline.

• Nitrogen Dioxide. The indoor and outdoor concentrations of nitrogen dioxide are summarized along with recommended indoor guidelines in Table 25. The basis for our selection of non-industrial irritant guidelines for nitrogen dioxide is the CARB 2001 (Table 4.1) recommendation of 150 $\mu g/m^3$ for a 24-hour exposure. The indoor concentrations, which ranged from < 9 $\mu g/m^3$ in P1 and P3 to 10 $\mu g/m^3$ in P2, were all well below this guideline.

• Particulate Matter ($PM_{2.5}$). The indoor and outdoor concentrations of $PM_{2.5}$ are summarized along with recommended indoor guidelines in Table 25. The basis for our selection of non-industrial irritant guidelines for nitrogen dioxide is the CARB 2001 (Table 4.1) recommendation of 65 $\mu g/m^3$ for a 24-hour exposure. The indoor concentrations which ranged from 11 $\mu g/m^3$ in P2 and P3 to 12 $\mu g/m^3$ (17 $\mu g/m^3$ duplicate) in P1, were all well below this guideline.

<u>Real-Time IAQ Measurements</u>

• Carbon Monoxide (CO). The indoor and outdoor concentrations of CO are summarized along with recommended indoor guidelines in Table 25. The basis for our selection of non-industrial irritant guidelines for CO is the CARB 2001 (Table 4.1) recommendation of 9 ppm for an 8-hour exposure and 20 ppm for a 1-hour exposure. For the 8-hour maximum exposures the indoor concentrations, which ranged from less than 0.5 ppm in P2 to 1.0 ppm (<0.5 ppm duplicate) in P1 to 1.4 ppm in P3, were all well below the 8-hour guideline of 9 ppm. For the 1-hour maximum exposures the indoor concentrations, which ranged from less than 0.5 ppm in P2 to 1.6 ppm (<0.5 ppm duplicate) in P1 to 1.8 ppm in P3, were all well below the 1-hour guideline of 20 ppm.

• Carbon Dioxide ($CO_2$). The indoor and outdoor concentrations of $CO_2$ are summarized along with recommended indoor guidelines in Table 26. The basis for our selection of non-industrial irritant guidelines for $CO_2$ is the ASHRAE 62.1-2004 guideline of a maximum indoor concentration of less than 700 ppm above the outdoor concentration. We note that this guideline is established for body odor and not health concerns.

The maximum $CO_2$ concentration ranged from 2,251 ppm (2,236 ppm duplicate) in P1 to 1,228 ppm in P2 to 1,343 ppm in P3. Thus the maximum concentration of $CO_2$ exceeded the ASHRAE recommended maximum of 700 ppm over outdoors in P1 and P3. We also note that the maximum indoor $CO_2$ concentrations in all three homes occurred during the time that the field teams were either deploying or retrieving the air sampling equipment. Figure 13 is a plot of the $CO_2$ indoor concentration as a function of time for the 24-hour sampling period. In this home, there were a large number of observers and field technicians present (e.g., 6–8) at the start of the air sampling contributing to the indoor $CO_2$ air concentrations. In the main field study, there will be only two field technicians present at any one time.

• Temperature and Relative Humidity. The indoor and outdoor temperature and relative humidity measurements are summarized in Table 26. The 24-hour average indoor air temperatures ranged from 67°F (67°F duplicate) at P1 to 68°F at P2 to 64°F at P3. The average outdoor temperature averaged 45°F at the P1/P2 outdoor site and 49°F at the P3 outdoor site. The 24-hour average indoor relative humidity ranged from 42% (41% duplicate) at P1 to 35% at P2 to 52% at P3. The average outdoor relative humidity averaged 70% at the P1/P2 outdoor site and 90% at the P3 outdoor site.

## QUALITY ASSURANCE AND QUALITY CONTROL

The results of the air sampling flow rate stability analyses are summarized in Table 27. This table summarizes the minimum, maximum, and average of the standard deviations in the recorded start and stop sample flow rates.

For the VOC measurements, a total of two samplers were deployed at each sampling site. The second sample was collected as a back-up sample to the first, should the sample be overloaded. Of the 12 VOC air samples (i.e., 6 pairs of 2 samples) the average relative standard deviation was 0.08 with a minimum of 0.0 and a maximum of 0.23. From each pair of VOC samplers at each site the sampler with the more stable flow rate was submitted for analyses. For the 6 VOC air samples submitted, the average relative standard deviation was 0.03, with a minimum of 0.0 and a maximum of 0.07.

For the $NO_2$ measurements, the average relative standard deviation was 0.03, with a minimum of 0.01 and a maximum of 0.05.

For the formaldehyde/acetaldehyde measurements, the average relative standard deviation was 0.11 with a minimum of 0.02 and a maximum of 0.54. We note that the outdoor sample for P3 had an atypically high relative standard deviation associated with the start and stop flow rates. The sample start flow rate was 101 cc/min, and the sample stop flow rate was 45 cc/min. If we eliminate this one sample, then the average relative standard deviation was 0.03 with a minimum of 0.02 and a maximum of 0.05. We note that there was very heavy rain during the start of this air sampling, and we suspect that the DNPH sampler swallowed a drop of rain water during the startup of the sampler. The field technician reports that he did not have an umbrella to protect the air samplers during the time that the radiation/rain shield was off and the sample start flow rates were being measured. For the main field study the field teams will make sure to pack umbrellas.

For the $PM_{2.5}$ measurements, the average relative standard deviation was 0.03 with a minimum of 0.01 and a maximum of 0.04.

The results of the carbon monoxide and carbon dioxide calibration stability analyses are summarized in Table 28. This table summarizes the minimum, maximum, and average difference between the post-calibration check reported by the instrument and the actual calibration concentration.

For carbon monoxide the six zero calibration checks averaged a 0 ppm difference with a minimum difference of 0 ppm and a maximum difference of 0 ppm. For carbon monoxide the six span calibration checks averaged a 1 ppm difference with a minimum difference of -3 ppm and a maximum difference of 1 ppm.

For carbon dioxide the six zero-calibration checks averaged a 21 ppm difference with a minimum difference of 0 ppm and a maximum difference of 63 ppm. For carbon dioxide the six span calibration checks averaged a 39 ppm difference with a minimum difference of -16 ppm and a maximum difference of 120 ppm. We note that the outdoor sample for P3 had an atypically large difference associated with the stop calibration. If we eliminate this one sample, then the calibrations averaged a 22 ppm difference with a minimum difference of -16 ppm and a maximum difference of 60 ppm.

The results of the VOC sample duplicate analyses are summarized in Tables 29 and 30. This table summarizes for each VOC the relative standard deviation between the pair of duplicate samples collected in P1 where both samples were above the quantification limit. The relative standard deviation ranged from 0.00 to 0.19. Only two compounds had relative standard deviations greater than 0.09: 0.15 for 2,2,4-Trimethyl-1,3-pentanediol momoisobutyl ether, isomer 3, and 0.19 for d-limonene.

The results of the sample duplicate analyses for acetaldehyde, formaldehyde, carbon dioxide, carbon monoxide, nitrogen dioxide, and $PM_{2.5}$ are summarized in Table 31. This table summarizes, for each compound, the relative standard deviation between the pair of duplicate samples collected where both samples were above the quantification limit.

The results of the sample duplicate analyses for the PFT measurements are summarized in Tables 32. This table summarizes the relative standard deviation between the pair of duplicate samples. For the 24-hour short-term PFT measurements of outdoor air exchange rate the relative standard deviation ranged from 0.00 for the P1 pair of samples to 0.03 for the P2 pair of samples. For the two-week long-term PFT measurements of outdoor air exchange rate the relative standard deviation was 0.09 for the P3 pair of samples. For the 24-hour short-term PFT measurements of garage source entry into the home the relative standard deviation ranged from 0.20 for the P1 pair of samples to 0.11 for the P2 pair of samples. For the two-week long-term PFT measurements of garage source entry into the home the relative standard deviation was 0.01 the P3 pair of samples.

The single VOC field blank sample analyzed contained only one compound above the minimum mass quantification limit, ethanol with a field blank mass of 129 ng and a minimum quantification limit of 75 ng. A total of seven additional compounds had detectable concentrations in the field blank but with masses all below the quantification limit. These compounds were:

Acetephenone: 1 ng blank – 5 ng minimum quantification limit
Benzaldehyde: 4.4 ng blank – 5 ng minimum quantification limit
Butanol: 16.8 ng blank – 25 ng minimum quantification limit
Decanal: 10 ng blank – 5 ng minimum quantification limit
Limonene: 3.2 ng blank – 5 ng minimum quantification limit

Nonanal: 6.8 ng blank – 50 ng minimum quantification limit
Octanal: 1.3 ng blank – 25 ng minimum quantification limit

For acetaldehyde, the single field blank sample analyzed contained a detectable mass of 34 ng, which is below the minimum mass quantification limit of 40 ng.

For formaldehyde, the single field blank sample analyzed contained no detectable mass.

For nitrogen dioxide the single field blank sample analyzed contained no detectable mass.

For $PM_{2.5}$. the four field blank samples analyzed contained detectable masses averaging -3.25 µg, and ranging from -1 µg to -6 µg. These sample blank masses are below the minimum mass quantification limit of 10 µg.

DIFFICULTIES ENCOUNTERED IN THE PILOT STUDY

The following are difficulties that we encountered during the pilot study, followed by the corrective action that that will be incorporated onto the main study.

1.) During inspection of the pilot homes we had problems with dust and debris from the attic falling out of the access onto surfaces in the occupied space of the home.
    Future action: Field teams that access the attic will be equipped with portable HEPA vacuums to clean up the dust and debris at the end of their inspection.

2.) Following installation of loggers on the surfaces of windows or doors that are most commonly used, we experienced difficulty with the logger tape losing its adhesion properties over time, resulting in loggers falling to the floor. Homeowners were quick to report that the loggers had fallen off resulting in minimal data loss.
    Future action: The field team has selected and utilized with success a tape adhesive that keeps the loggers attached to these surfaces for the required duration of time.

3.) Following collection of HOBO loggers by Team 3 and during shipping of the loggers back to Team 1, one of the loggers was broken.

Future action: Special shipping boxes will be employed to ensure that loggers are protected during shipping to prevent damage to the instrument and loss of the contained data.

4.) The comparison of the data logger records of window openings and the occupant written logs indicate that the occupants logged only one of the data logger recorded openings.

Future action: Consider improving the communication and occupant written logging methods to increase the accuracy with which the occupants log their window openings.

5.) During setup and launching of loggers the logging interval on a single logger was incorrectly set so that the logger became full before the end of the required sampling duration.

Future action: The protocol for setup and launching of loggers will be evaluated to see if the standard operating procedures can be modified to prevent this from happening.

6.) Following installation of a the logger on the heating/cooling mechanical system of one pilot home, the homeowner called to report that their heating/cooling mechanical system no longer worked. It was discovered by field staff that heating/cooling mechanical system door had not been replaced correctly.

Future action: The protocol for instillation of the heating/cooling mechanical system logger will be evaluated to see if the standard operating procedures can be modified to prevent this from happening.

7.) The fifth and final blower door test failed three times in the field due to pressure fluctuations experienced during the collection of the last and lowest pressure data point. Since the blower door software we were using (Tectite 1.0) does not save any of the data from failed tests, we lost all of the data from this test.

Future action: We have since upgraded to Tectite 3.1, which allows the user to save the data from interrupted failed tests.

8.) The large change in the air sampling rate for the outdoor formaldehyde sample at P3 has been attributed to entrainment of rain drops into the DNPH sampler during the time that the field technician had the radiation/rain shield off and was calibrating the starting sample flow rates.

Future action: We will include umbrellas with each of the field teams to protect the outdoor air samples during the start and stop calibrations.

9.) Not enough time to complete all of the pilot field measurements with two-man field crews in the three-hour allotted time periods. This is especially true for Field Team 3, which conducted five blower door tests, and three pressurization duct leakage tests in addition to the shutting down the air samplers and PFTs and measuring all of the mechanical ventilation system flow rates.

Future action: We will work with the ARB, the Energy Commission, and the Science Advisory Board to streamline the field protocols for each of the three field times so that quality work can be performed within the three hours of field time allocated to each of the three field teams.

## CONCLUSIONS

The field SOPs and laboratory analyses developed for the pilot study appear to be acceptable for deployment in the main field study, which begins this summer in July and August 2006. Based upon the results from the three-home pilot study, we look forward to working with the ARB, the Energy Commission, and the Science Advisory Board to make refinements and improvements in the field SOPs and laboratory analyses that can improve the quality of the collected data.

Table 1. Home characteristics collected in P1, P2, and P3 pilot test homes.

| **House Characteristics** | | | |
|---|---|---|---|
| House ID | P1 | P2 | P3 |
| General | | | |
| Age of house | 2.5 yrs. | 2.75 yrs. | 2.5 yrs. |
| Number of stories | 1 | 1 | 2 |
| Foundation type (slab, basement, crawl-space) | Slab | Slab | Slab |
| Conditioned floor area ($ft^2$) | 2,500 | 1,670 | 2,580 |
| Conditioned envelope area ($ft^2$) | 5,450 | 3,834 | 5,200 |
| Conditioned air volume ($ft^3$) | 24,990 | 16,670 | 21,700 |
| Sources | | | |
| Number of occupants (Adults/Children) | 2/0 | 2/0 | 2/0 |
| Attached garage – Self closing / gasketed door | Yes / Yes | Yes / Yes | Yes / Yes |
| Cooking Fuel | G/E | G | G |
| Hot Water Fuel | G | G | G |
| Heating Fuel | G | G | G |
| Clothes Drying Fuel | E | E | E |
| Unvented Combustion Heaters | 0 | 0 | 0 |
| Carpeting ($ft^2$) | 1,512 | 923 | 1,862 |
| Composite Pressed Wood ($ft^2$) | 421 | 555 | 598 |
| Moisture Staining/Damage ($ft^2$) | 0 | 0 | 0 |
| Visible Potential Fungal Growth ($ft^2$) | 0 | 0 | 0 |
| Outdoor Sources (within 500 feet) | None | None | Yes [a] |
| Ventilation and Air Cleaning | | | |
| Exterior Window/Door Openings (% of floor area) | 5.6 | 5.7 | 5.5 |
| Forced Air System (Heating, Cooling) | Attic / H/C | Attic / H/C | Attic / H/C |
| Forced Air Filter Efficiency (MERV) | ~ 6 [b] | ~ 6 [b] | 8 |
| Forced Air Fan Control | Auto | Auto | Auto |
| Mechanical Outdoor Air Delivery System | Attic / Yes | Attic / Yes | No |
| Mechanical Outdoor Air Delivery System Control | Continuous | Continuous | NA |
| Mechanical OA System Filter Efficiency (MERV) | ~ 6 [b] | ~ 6 [b] | NA |
| Night Cooling System | Yes | No | No |
| Night Cooling System Controls | Auto | NA | NA |

a.) Construction road work and open fields.
b.) No ASHRAE 52.2 MERV rating. ASHRAE 52.1 average atmospheric dust spot efficiency is 3%.

Table 2. Homeowner reported home renovations, maintenance, and other IAQ-related activities collected in P1, P2, and P3 pilot test homes.

| Renovations, Maintenance, and Other IAQ-Related Activities | | | | |
|---|---|---|---|---|
| House ID | | P1 | P2 | P3 |
| Construction, Occupancy, Renovations, and Other IAQ-Related Activities | Construction Completion Date | 05/2003 | 03/31/03 | 08/2003 |
| | Move-in Date | 05/2003 | 04/01/03 | 08/2003 |
| | Are You the First Owner | Yes | Yes | Yes |
| | Number of Occupants | 2 | 2 | 2 |
| | Number of Cigarette/Cigar Smokers | 0 | 0 | 0 |
| | Number of Pets | 0 | 0 | 0 |
| | Are Shoes Worn in Home | Yes | No | No |
| | Renovations | No | No | Yes [a] |
| | Duct Cleaning | No | No | No |
| | Pesticide Applications | Yes [b] | No | Yes [b] |
| | Fire/Smoke Damage | No | No | No |
| Carpet Cleaning | Twice per Week, or More | | | |
| | Once per Week | X | X | |
| | Once per Fortnight | | | |
| | Once Every Three to Four Weeks | | | |
| | Less that Once per Month | | | X |
| | Last Vacuuming Date | 12/04/05 | 11/26/05 | 09/01/05 |
| | Last Spot Cleaning Date | 11/20/05 | 11/26/05 | 12/03/05 |
| Air Cleaners and Ventilation Fans | Portable Air Cleaners | No | No | No |
| | Vacuum Cleaners | Yes [c] | Yes [c] | Yes [c] |
| | Window Fans | No | No | No |
| | Window Air Conditioners | No | No | No |
| Air Fresheners and Other Sources | Air Fresheners (manual, continuous) | 1-manual | No | No |
| | Candles | Yes [d] | Yes [d] | Yes [d] |
| | Incense | No | No | No |
| | Mothballs | No | No | No |
| | Hobbies/Crafts | No | No | No |
| Chemical Storage Items | Paints, Thinners, Varnishes | Yes [e] | Yes [e] | Yes [f] |
| | Gasoline, Fertilizers, etc. | Yes [g] | No | Yes [e] |
| | Detergents, Bleach, Chlorine, etc. | Yes [f] | Yes [f] | Yes [g] |
| | Pesticides, Insecticides, etc. | Yes [g] | No | Yes [e] |

a.) Garage Painting 11/23/05.
b.) P1 exterior application on 11/1/05; P3 exterior application – no date
c.) P1 – B & D Dirt Buster/Orek XL 2Ceo-Hypo Allergenic Plus; P2 – Dirt Devil/Kenmore Whisper; P3 – Dirt Devil.
d.) P1 – 4; P2 – 7; P3 – 5.
e.) Garage
f.) Kitchen
g.) Shed/Storage Room

Table 3. Homeowner reported building system failures and home IAQ improvements collected in P1, P2, and P3 pilot test homes.

| Building System Failures and Home IAQ Improvements | | | |
|---|---|---|---|
| House ID | P1 | P2 | P3 |
| Building System Failures | | | |
| Condensation (includes windows/interior walls) | No | No | No |
| Roof Leaks | No | No | No |
| Plumbing Leaks | No | Yes | No |
| Window or Wall Leaks | No | No | No |
| Flooding | No | No | No |
| Poor Site Drainage | No | No | No |
| Bothersome Carpet Odors | No | No | No |
| Bothersome Cabinetry Odors | No | No | No |
| Other Moisture Problems | No | No | No |
| Home IAQ Improvements | | | |
| None (As Built Equipment/Configuration) | No | No | Yes |
| Upgrade Central Air Filter | Yes | Yes | No |
| High Efficiency Vacuum Cleaner (includes HEPA) | No | No | No |
| Entire House Vacuum System | No | No | No |
| Low-Emission Carpets, Cabinets, Furniture, etc. | No | Yes [a] | No |
| Carbon Monoxide Alarm | No | No | No |
| Special Range Hood | No | No | No |
| Extra Exhaust Fans | No | No | No |
| Entire House Ventilation System | Yes | No | No |
| Other | Yes [b] | No | No |

a.) Furniture
b.) Heat Recovery Ventilator (HRV)

Table 4. Homeowner reported source activities during the 24-hour ventilation and IAQ contaminant measurement period collected in P1, P2, and P3 pilot test homes.

| IAQ Source Activities | | | | |
|---|---|---|---|---|
| House ID | | P1 | P2 | P3 |
| Activities | | Duration in Minutes | | |
| Cooking Activities | Toasting | | | |
| | Frying | | | |
| | Sautéing | | | |
| | Baking | | | |
| | Broiling | | | |
| | Warming/Boiling Water, Soups, etc. | 7 | | 10 |
| | Microwave | | 1 | 14 |
| | Other | | | |
| Total Minutes | | 7 | 1 | 24 |
| Cleaning Activities | Vacuuming | | | |
| | Sweeping | | | |
| | Dusting | | | |
| | Floor Stripping | | | |
| | Floor Waxing | | | |
| | Use of Cleaners or Furniture Polish | | | |
| Total Minutes | | 0 | 0 | 0 |
| Occupant Special Activities | Smoking | | | |
| | Wood Burning | | | |
| | Candle Burning | | | |
| | Incense Burning | | | |
| | Painting | | | |
| | Nail Polish Application/Removal | | | |
| | Spray Air Fresheners | | | |
| | Large Party/Dinner Gatherings | | | |
| Total Minutes | | 0 | 0 | 0 |
| Outdoor Activities | Grass Cutting | | | |
| | Leaf Blowing/Sweeping | | | |
| | Painting | | | |
| | Barbecuing | | | |
| | Pesticide Application | | | |
| Total Minutes | | 0 | 0 | 0 |

a.) If no entry, then no minutes of activity.

Table 5. Homeowner-reported occupant perceptions and physical symptoms collected in P1, P2, and P3 pilot test homes.

| Occupant Perceptions and Physical Symptoms | | | |
|---|---|---|---|
| House ID | P1 | P2 | P3 |
| Environmental Conditions | | | |
| Too Hot | No | No | No |
| Too Cold | No | No | Yes |
| Too Dry | No | No | No |
| Too Humid | No | No | No |
| Too Drafty | No | Yes | No |
| Too Stagnant | No | No | No |
| Too Dusty | No | Yes | No |
| Mold, Mildew, or Other Odors | | | |
| Bathroom | No | No | No |
| Basement/Crawlspace | NA | NA | NA |
| Walls or Ceilings | No | No | No |
| Carpets | No | No | No |
| Cabinetry | No | No | No |
| Other | Yes [a] | No | No |
| Physical Symptoms | | | |
| Eye Irritation | No | No | No |
| Nose/Sinus Congestion | Yes | No | No |
| Nose Irritation | No | No | No |
| Allergy Symptoms | Yes | Yes | No |
| Headache | Yes | No | No |
| Skin Irritation | No | No | No |
| Difficulty Concentrating | No | No | No |
| Asthma Symptoms | No | No | No |
| Other | No | No | No |
| Diagnosed Conditions | | | |
| Allergies | Yes | No | No |
| Asthma | Yes | No | No |
| Chemical Sensitivity | No | No | No |
| | | | |

a.) Tap Water

Table 6. Occupant use of windows and doors collected by occupant logs in P1, P2, and P3 pilot test homes.

| Location | Day 1 ($ft^2$*hr) | Day 2 ($ft^2$*hr) | Day 3 ($ft^2$*hr) | Day 4 ($ft^2$*hr) | Day 5 ($ft^2$*hr) | Day 6 ($ft^2$*hr) | Day 7[a] ($ft^2$*hr) |
|---|---|---|---|---|---|---|---|
| Pilot Home 1 | | | | | | | |
| Window & Door Opening Area*Hours Open | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Pilot Home 2 | | | | | | | |
| Window & Door Opening Area*Hours Open | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 |
| Pilot Home 3 | | | | | | | |
| Window & Door Opening Area*Hours Open | 0.0 | 37.7 | 0.0 | 0.0 | 0.6 | 163.1 | 50.8 |

a.) Day 7 is the 24-hour test period during which indoor air quality contaminant parameters were measured.

Table 7. Bathroom and laundry exhaust flow rate measurements in P1, P2, and P3 pilot test homes.

| Location | Exhaust (CFM) | | Exhaust (ACH) | Ventilation by Exterior Openings (% floor area) | Area of Exterior Openings ($ft^2$) |
|---|---|---|---|---|---|
| Pilot Home 1 – 2,499 sq ft | Continuous [a] | Intermittent [a] | | | |
| Master Bathroom | 46 | na | 2.2 | 24 | 5.0 |
| Master Bathroom Toilet Room | na | 41 | 16 | 4.0 | 3.7 |
| Bathroom #2 | na | 19 | 2.1 | 5.5 | 3.1 |
| Laundry | 41 | na | 4.7 | 0 | 0 |
| Pilot Home 2 – 1,667 sq ft | | | | | |
| Master Bathroom | 68 | na | 6.7 | 5.7 | 3.4 |
| Master Bathroom Toilet Room | na | 49 | 19 | 0 | 0 |
| Bathroom #2 | na | 37 | 4.2 | 7.4 | 3.9 |
| Laundry | 62 | na | 8.1 | 0 | 0 |
| Pilot Home 3 – 2,583 sq ft | | | | | |
| Master Bathroom | na | 86 | 3.7 | 3.7 | 6.4 |
| Master Bathroom Toilet Room | na | 51 | 7.1 | 0 | 0 |
| Bathroom #2 | na | 39 | 6.0 | 0 | 0 |
| Bathroom #3 | na | 42 | 4.6 | 0 | 0 |
| Laundry | na | 38 | 8.3 | 0 | 0 |
| ASHRAE 62.2-2003 Guidelines [b] | 20 | 50 | na | 4[c] | 1.5 |
| California Building Code 2001[b] | na | na | 5 | 5 (4 for toilet rooms) | 1.5 – bath, toilet & laundry rooms |

a.) na indicates that the value was not reported because the mechanical fan was not operated in this mode.
b.) na indicates no applicable guidelines reported.
c.) ASHRAE 63.2-2004 guideline of ventilation openings not less than 4% of the floor area with a minimum of 1.5 $ft^2$. Exception: Utility rooms with dryer exhaust duct and toilet rooms within bathrooms.

Table 8. Kitchen exhaust flow rate measurements in P1, P2, and P3 pilot test homes.

| Location | Intermittent Exhaust Minimum / Maximum CFM | Continuous Exhaust Minimum / Maximum ACH |
|---|---|---|
| Pilot Home 1 | | |
| Kitchen | 213 / 249 | na |
| Pilot Home 2 | | |
| Kitchen | 298 / 392 | na |
| Pilot Home 3 | | |
| Kitchen | 175 / 305 | na |
| ASHRAE 62.2 Recommended Guidelines | 100 | 5 |

a.) na indicates that the value was not reported because the mechanical fan was intermittently operated.

Table 9. Exhaust fan flow rate operation measurements in P1, P2, and P3 pilot test homes.

| Location | Flow rate (cfm) | Day 1 (cfm*hr) | Day 2 (cfm*hr) | Day 3 (cfm*hr) | Day 4 (cfm*hr) | Day 5 (cfm*hr) | Day 6 (cfm*hr) | Day 7[b] (cfm*hr) |
|---|---|---|---|---|---|---|---|---|
| Pilot Home 1 | | | | | | | | |
| Kitchen | 213/249 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Master Bath Room [a] | 46 | 1,104 | 1,104 | 1,104 | 1,104 | 1,104 | 1,104 | 1,104 |
| Master Bath Room Toilet | 41 | 0 | 0 | 0 | 1 | 8 | 46 | 0 |
| Bath Room #2 | 19 | 12 | 10 | 36 | 44 | 26 | 6 | 28 |
| Laundry [a] | 41 | 984 | 984 | 984 | 984 | 984 | 984 | 984 |
| Cloths Dryer | 136 | 374 | 580 | 256 | 0 | 165 | 117 | 57 |
| Totals | | 2473 | 2678 | 2380 | 2133 | 2286 | 2257 | 2173 |
| Pilot Home 2 | | | | | | | | |
| Kitchen | 298/392 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Master Bath Room [a] | 68 | 1,632 | 1,632 | 1,632 | 1,632 | 1,632 | 1,632 | 1,632 |
| Master Bath Room Toilet | 49 | 2 | 55 | 16 | 25 | 0 | 22 | 21 |
| Bath Room #2 | 37 | 9 | 12 | 13 | 12 | 0 | 0 | 0 |
| Laundry [a] | 62 | 1,488 | 1,488 | 1,488 | 1,488 | 1,488 | 1,488 | 1,488 |
| Cloths Dryer | 118 | 0 | 197 | <1 | 303 | <1 | 56 | 4 |
| Totals | | 3,131 | 3,384 | 3,149 | 3,461 | 3,120 | 3,198 | 3,145 |
| Pilot Home 3 | | | | | | | | |
| Kitchen | 175/305 | 0 | 0 | 66 | 0 | 178 | 92 | 0 |
| Master Bath Room | 86 | 26 | 0 | 31 | 0 | 0 | 0 | 7 |
| Master Bath Toilet Room | 51 | 69 | 77 | 11 | 32 | 11 | 2 | 74 |
| Bath Room #2 | 39 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bath Room #3 | 42 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Laundry Room | 38 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cloths Dryer | 99 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Totals | | 96 | 77 | 107 | 32 | 189 | 94 | 82 |

a.) Mechanical heat recovery ventilation (HRV) system exhaust air flowrates – continuous.
b.) Day 7 is the 24-hour test period during which the tracer gas air exchange rate and indoor air quality contaminant parameters were measured.

Table 10. Return air flow rates and forced air heating/cooling system percent on-time in P1, P2, and P3 pilot test home.

| Location | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7 [a] |
|---|---|---|---|---|---|---|---|
| Pilot Home 1 | | | | | | | |
| Forced air heating/cooling system on-time (%)<br>Return air flow rate – 1,180 cfm | 13 | 8 | 7 | 20 | 14 | 19 | 15 |
| Pilot Home 2 | | | | | | | |
| Forced air heating/cooling system on-time (%)[b]<br>Return air flow rate – 928 cfm | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pilot Home 3 | | | | | | | |
| Forced air heating/cooling system on-time (%)<br>Return air flow rate–1,010/1,160 cfm [b] | 2 | 6 | 15 | 23 | 13 | 18 | 17 |

a.) Day 7 is the 24-hour test period during which indoor air quality contaminant parameters were measured.
b.) Dual zone system: cfm on low speed – one zone / cfm on high speed – two zones.

Table 11. Mechanical outdoor air ventilation measurements in P1, P2, and P3 pilot test homes.

| Location | Floor Area ($ft^2$) | # Bedrooms | Percent On-time (%) | Outdoor Air Flow Rate (cfm) | Air Changes per Hour | ASHRAE Guidelines [a] (cfm / ach) | Energy Commission Guidelines [b] (cfm / ach) |
|---|---|---|---|---|---|---|---|
| Pilot Home 1 | 2,500 | 3 | 100[d] | 88 | 0.21 | 55 / 0.14 | 118 / 0.28 |
| | | | 0[e] | 1,180 | 0 | | |
| Pilot Home 2 | 1,670 | 2 | 100[d] | 132 | 0.48 | 39 / 0.15 | 78 / 0.28 |
| Pilot Home 3[c] | 2,580 | 3 | na | na | na | 56 / 0.16 | 121 / 0.33 |

a.) ASHRAE 62.2 Recommended Guidelines for ventilation requirements on a cubic feet per minute (cfm) / air changes per hour (ach) basis.
b.) California Energy Commission, Title 24, 2001 Residential ACM Approval Manual. If Standard Leakage Area is:
> 3.0 - no mechanically supplied outdoor air (OA) required.
1.5 < 3.0 - mechanically supplied OA required, minimum of 0.047 cfm/$ft^2$ conditioned floor area.
< 1.5 - mechanically supplied OA required, house maintained greater than -5 Pa with all continuous ventilation fans operating.
c.) na indicates no mechanical whole building ventilation provided.
d.) Operation of heat recovery ventilation system (HRV).
e.) Operation of night time cooling ventilation system.

Table 12. Forced air heating/cooling system fan pressurization duct leakage areas measurements in P1, P2, and P3 pilot test homes.

| Location | Pilot Home 1 | Pilot Home 2 | Pilot Home 3[c] | Guidelines [a, b] |
|---|---|---|---|---|
| Forced air heating/cooling system return air flow rate (cfm)[b] | 1,180 | 928 | 1,010/1,160 | na |
| Forced Air System at 25 pascals, registers sealed with tape | | | | |
| Percent leakage of total system flow rate (%) | 4.9 | 4.9 | na | <15% |
| Forced Air System at 25 pascals, registers sealed, home at 25 pascals | | | | |
| Percent leakage of total system flow rate (%) | 4.6 | 3.0 | na | <15% |
| Forced Air System at 25 pascals, registers unsealed, home at 25 pascals | | | | |
| Percent leakage of total system flow rate (%) | 2.5 | 0.2 | na | <15% |

a.) California Energy Commission, Title 24, 2001 Energy Efficiency Standards for Residential and Nonresidential Buildings.
b.) dual zone system: cfm on low speed – one zone / cfm on high speed – two zones.
c.) na indicates data was not collected due to occupant request to end testing because of noise/disruption to a new baby.

Table 13. Forced air heating/cooling system Delta-Q duct leakage areas measurements in P1, P2, and P3 pilot test homes.

| Location | Pilot Home 1 | Pilot Home 2 | Pilot Home 3[a] |
|---|---|---|---|
| Delta-Q | | | |
| Supply leakage (cfm)[b] | 61 | 20 | na |
| Return leakage (cfm)[b] | 42 | 43 | na |
| Total (cfm) | 103 | 63 | na |

a.) na indicates data was not collected due to occupant request to end testing because of noise/disruption to a new baby.
b.) Uncertainty of the measurement is +/- 20 cfm.



Table 14. Home differential pressure measurements with the forced air system on and off in P1, P2, and P3 pilot test homes.

| Location | Pilot Home 1 | Pilot Home 2 | Pilot Home 3 | Guideline [a] |
|---|---|---|---|---|
| Home Air Pressure with Respect to Outdoors | | | | |
| Forced air heating/cooling system off (Pa) | -1.2 | -1.0 | -1.1 | -5 |
| Forced air heating/cooling system on (Pa) | -1.0 | -0.8 | -1.5 | |

a.) California Energy Commission, Title 24, 2001 Residential ACM Approval Manual. If the Standard Leakage Area is less than 1.5, then mechanically supplied OA is required, and the house air pressure with respect to outdoors must be greater than -5 Pa with all continuous ventilation fans operating.

Table 15. Building air leakage area measurements in P1, P2, and P3 pilot test homes.

| Location | Pilot Home 1 | Pilot Home 2 | Pilot Home 3[a] | Guidelines [b, c] |
|---|---|---|---|---|
| Indoor Temperature ($^{\circ}$F) - HOBO/Q-Trak | 68 / 67 | 68 / 68 | 68 / 64 | na |
| Outdoor Temp. ($^{\circ}$F) - HOBO/weather data | 47 / 44 | 44 | 51 | |
| Wind Speed (mph) | 0.5 | 1.4 | 5.8 | na |
| Effective Leakage Area@4 Pa (in$^2$) | | | | |
| Depressurization | 98.8 | 95.3 | 76.3 | na |
| Pressurization | 95.4 | 91.0 | na | na |
| Average | 97.1 | 93.2 | na | na |
| Air Changes Per Hour at 50 Pa | | | | |
| Depressurization | 4.31 | 6.26 | 3.97 | na |
| Pressurization | 3.80 | 5.85 | na | na |
| Average | 4.06 | 6.06 | na | na |
| Standard Leakage Area | | | | |
| Depressurization | 2.74 | 3.97 | 2.05 | >3.0 |
| Pressurization | 2.65 | 3.79 | na | 1.5 < 3.0 |
| Average | 2.70 | 3.88 | na | < 1.5 |

a.) na indicates measurements not available due to unstable pressure measurement.
b.) California Energy Commission, Title 24, 2001 Residential ACM approval Manual.
> 3.0 - no mechanically supplied outdoor air (OA) required.
1.5 < 3.0 - mechanically supplied OA required, minimum of 0.047 cfm/ft$^2$ conditioned floor area.
< 1.5 - mechanically supplied OA required, house maintained greater than -5 Pa with all continuous ventilation fans operating.
c.) na indicates no applicable guidelines reported.

Table 16. House to garage air leakage measurements in P1, P2, and P3 pilot test homes.

| Location | Pilot Home 1 | Pilot Home 2 | Pilot Home 3 | Guidelines [a, b] |
|---|---|---|---|---|
| House to garage pressure with house at -50 Pa to outdoor air (pascals) | -49.5 | -49.4 | -49.8 | >-49 |
| House to garage leakage area, EqLA at 10 Pa (inches$^2$) | 20 (+/- 15) | 8.5 (+/- 8.5) | 4 (+/- 4) | na |
| Garage to outdoors leakage area, EqLA at 10 Pa (inches$^2$) | 433 (+/- 14) | 193 (+/- 19) | 141 (+/- 8) | na |
| House to garage leakage area / (house to outdoors leakage area + garage to outdoors leakage area) * 100 (%) | 3 | 2 | 1 | na |

a.) American Lung Association. Healthy House Builder Guidelines 2004.
b.) na indicates that no applicable guidelines were reported.

Table 17. PFT tracer measurements of the outdoor air exchange rate in P1, P2, and P3 pilot test homes.

| Location | Pilot Home 1 | Pilot Home 2 | Pilot Home 3 |
|---|---|---|---|
| Short Term | | | |
| Duration (Days) | 0.93 | 0.99 | 0.96 |
| Sample 1 (Outdoor air changes per hour) | 0.37 | 0.73 | 0.26 |
| Sample 1 Duplicate (Outdoor air changes per hour) | 0.37 | 0.71 | na |
| Long Term | | | |
| Duration (Days) | 13.97 | 13.98 | 21.97 |
| Sample 1 (Outdoor air changes per hour) | 0.29 | 0.57 | 0.30 |
| Sample 1 Duplicate (Outdoor air changes per hour) | na | na | 0.34 |

a.) na indicates that there was no sample collected.

Table 18. Short- and long-term measurements of home to garage zone air leakage using PFT tracer in P1, P2, and P3 pilot test homes.

| Location | Pilot Home 1 | Pilot Home 2 | Pilot Home 3 |
|---|---|---|---|
| Short Term | | | |
| Duration (Days) | 0.93 | 0.99 | 0.96 |
| Sample 1 (% garage source into home) | 2.6 | 10.1 | 9.8 |
| Sample 1 Duplicate (% garage source into home) | 1.9 | 11.9 | na |
| Long Term | | | |
| Duration (Days) | 13.97 | 13.98 | 21.97 |
| Sample 1 (% garage source into home) | 4.0 | 7.2 | 11.3 |
| Sample 1 Duplicate (% garage source into home) | na | na | 11.4 |

a.) na indicates that there was no sample collected.

Table 19. Outdoor air ventilation rates calculations for P1, P2, and P3 Pilot test homes.

| Location | Pilot Home 1 | Pilot Home 2 | Pilot Home 3 |
|---|---|---|---|
| Natural outdoor air exchange rate [a] | 0.12 | 0.18 | 0.10 |
| Balanced mechanical outdoor air exchange rate [b] | 0.23 | 0.48 | 0.00 |
| Unbalanced mechanical outdoor air exchange rate [c] | 0.01 | 0.02 | 0.01 |
| Natural + mechanical outdoor air exchange rate (ASHRAE 136) [d] | 0.35 | 0.66 | 0.12/0.10[f] |
| Natural + mechanical outdoor air exchange rate (Palmiter/Bond 0.5 Rule) [e] | 0.36 | 0.66 | 0.12/0.11[f] |
| PFT Measurement | 0.37 | 0.72 | 0.26 |
| Window / Door Opening ($ft^2$-hr) | 0.0 | 0.1 | 50.8 |
| Energy Commission Guideline [g] | 0.35 | 0.35 | 0.35 |

a.) Calculated using the “Enhanced Method” in ASHRAE Fundamentals, Chapter 27.
b.) Smaller of the total 24-hour average exhaust air or outdoor airflow rate.
c.) Larger – smaller of the total 24-hour average exhaust air or outdoor airflow rate.
d.) Calculated according to ASHRAE 136-1993 (RA2001). The total outdoor air ventilation rate equals the smaller of the total supply and total exhaust airflow + the square root of (the absolute value of the difference between the total supply and total exhaust airflow) squared + the infiltration airflow squared).
e.) Palmiter/Bond 0.5 Rule. If the unbalanced mechanical ventilation flow rate < 2 * the natural infiltration rate, then the total outdoor air ventilation rate is calculated by the balance portion of the mechanical ventilation flow rate + the natural infiltration rate + 1/2 the unbalanced portion of the mechanical ventilation flow rate. If the unbalanced mechanical ventilation flow rate > 2 * the natural infiltration rate, then the total outdoor air ventilation rate is calculated by taking the greater of the exhaust or outdoor air flow rate.
f.) Calculated using P2 supply air and return air forced air heating/cooling system duct air leakage / Calculated without any supply air and return air forced air heating/cooling system duct air leakage.
g.) California Energy Commission, Title 24, 2001 Residential ACM Approval Manual guideline for natural + mechanical outdoor air exchange rate.

Table 20. Concentrations of individual volatile organic compounds measured indoors and outdoors at P1, P2, and P3 pilot test homes.

**Concentrations of Volatile Organic Compounds (µg/m$^3$)**

| Compound | Detection Limit | P1 Indoors | P1 Indoor Duplicate | P2 Indoors | P1 (P2)[a] Outdoors | P3 Indoors | P3 Outdoors | Indoor Guideline |
|---|---|---|---|---|---|---|---|---|
| Acetic acid | est. 0. 4 | | | | | | | 625 [c] |
| Acetonitrile | est. 0.4 | | | | | | | 1,750 [c] |
| Acetophenone | 0.4 | 0.7 | 0.6 | 0.5 | 0.5 | 1.5 | 0.4 | 1,225 [c] |
| Benzaldehyde | 0.4 | 3.2 | 3.6 | 2.6 | 0.3 | 4.4 | 2.0 | na |
| Benzene | 0.4 | 3.7 | 3.8 | 3.1 | 2.8 | 3.1 | 2.0 | 60 [b] |
| 1-Butanol | 2 | 3.4 | 3.6 | 4.6 | | 5.3 | | 3,750 [c] |
| 2-Butanone | 0.8 | | | | | | | 14,750 [c] |
| 2-Butoxyethanol | 0.4 | 4.0 | 4.1 | 1.3 | | 36 | | 3,000 [c] |
| tert-Butyl methyl ether | 0.4 | 4.4 | 4.5 | | | | | 8,000 [b] |
| Caprolactam | 0.8 | | | | | | | 500 [c] |
| Carbon tetrachloride | 0.4 | | | | | | | 40 [b] |
| Chloroform | 0.4 | | | | | | | 300 [b] |
| Cresol mix | 0.4 | | | | | | | 600 [b] |
| Cyclohexane | est. 2 | 7.0 | 7.3 | | | | | 26,250 [c] |
| Decanal | 4 | | | | | | 7.7 | na |
| n-Decane | 0.4 | | | | | | | na |

a.) Outdoor air sampled at one location, P1, for the two-home cluster of P1 and P2.
b.) OEHHA Chronic Reference Exposure Levels, 2003. na = no available guideline.
c.) 1/40th the 8-hour occupational health guideline (e.g., the California Division of Occupational Safety and Health (Cal/OSHA) Permissible Exposure Limits (PELs), American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs), Deutsche Forschungsgemeinschaft (DFG) Maximum Allowable Concentrations (MAKs) . na = no available guideline.

Note: Samples with no values reported are below the detection limit.

Table 21. Concentrations of individual volatile organic compounds measured indoors and outdoors at P1, P2, and P3 pilot test homes.

**Concentrations of Volatile Organic Compounds (µg/m$^3$)**

| Compound | Detection Limit | P1 Indoors | P1 Indoor Duplicate | P2 Indoors | P1 (P2)[a] Outdoors | P3 Indoors | P3 Outdoors | Indoor Guideline |
|---|---|---|---|---|---|---|---|---|
| Di(ethylene glycol)butyl ether | est. 2 | | | | | 3.7 | | na |
| 1,4-Dichlorobenzene | 0.4 | | | | | | | 800 [b] |
| 1,1-Dichloroethene | 2 | | | | | | | 70 [b] |
| n-Dodecane | 0.4 | | | | | | | na |
| Ethanol | 6 | 1,173 | 1,181 | | 221 | 162 | | 47,500 [c] |
| Ethoxyethanol | 0.4 | | | | | | | 450 [c] |
| 2-Ethoxyethyl acetate | 0.4 | | | | | | | 675 [c] |
| Ethyl acetate | est. 0.4 | 2.2 | 2.1 | | 2.8 | 5.2 | | 35,000 [c] |
| 2-Ethyl-1-hexanol | 0.8 | | 0.9 | | | 1.2 | | 6,750 [c] |
| Ethylbenzene | 0.4 | 2.1 | 1.9 | 1.2 | 1.2 | 4.3 | | 2,000 [b] |
| Ethylene glycol | est. 2 | 14 | 14 | | 8.0 | | | 400 [b] |
| 2-Furancarboxaldehyde | 0.4 | 1.4 | 1.4 | | 1.1 | 4.4 | | na |
| Heptanal | 0.4 | 0.6 | 0.6 | | | 1.9 | | na |
| n-Heptane | 0.4 | | | | | | | 40,000 [c] |
| Hexanal | 2 | 10 | 9.8 | | 2.9 | 33 | | na |

a.) Outdoor air sampled at one location, P1, for the two-home cluster of P1 and P2.
b.) OEHHA Chronic Reference Exposure Levels, 2003. na = no available guideline.
c.) 1/40th the 8-hour occupational health guideline (e.g., Cal/OSHA PELs, ACGIH TLVs, DFG MAKs). na = no available guideline.

Note: Samples with no values reported are below the detection limit.

Table 22. Concentrations of individual volatile organic compounds measured indoors and outdoors at P1, P2, and P3 pilot test homes.

**Concentrations of Volatile Organic Compounds (µg/m$^3$)**

| Compound | Detection Limit | P1 Indoors | P1 Indoor Duplicate | P2 Indoors | P1 (P2)[a] Outdoors | P3 Indoors | P3 Outdoors | Indoor Guideline |
|---|---|---|---|---|---|---|---|---|
| n-Hexane | 0.4 | 3.8 | 3.9 | 3.0 | 2.5 | 3.3 | | 7,000 [b] |
| d-Limonene | 0.4 | 24 | 19 | 3.1 | 0.5 | 22 | 1.7 | na |
| 1-Methoxy-2-propanol | 0.4 | | | | | | | 9,225 [c] |
| 2-Methoxyethanol | est. 2 | | | | | | | 400 [c] |
| 2-Methoxyethyl acetate | 0.4 | | | | | | | 600 [c] |
| 4-Methyl-2-pentanone (MIBK) | 0.4 | 0.5 | 0.5 | | | 0.6 | | 17,500 [c] |
| 1-Methyl-2-pyrrolidinone | 0.4 | | | 0.9 | | | | 2,000 [c] |
| Naphthalene | 0.4 | | | | | | | 9 [b] |
| Nonanal | 4 | | 4.7 | 3.6 | | 9.6 | 3.7 | na |
| Octanal | 2 | | | | | 2.5 | | na |
| Pentanal | 2 | 8.2 | 7.9 | 3.7 | | 21.3 | | na |
| Phenol | 4 | | | | | | | 200 [b] |
| alpha-Pinene | 0.4 | 13 | 14 | 10 | 0.9 | 29 | | 2,800 [c] |
| beta-Pinene | 0.4 | 3.0 | 3.1 | 1.1 | | 4.2 | | 2,800 [c] |
| 2-Propanol | 0.8 | 146 | 149 | 18 | | 6.5 | | 7,000 [b] |

a.) Outdoor air sampled at one location, P1, for the two-home cluster of P1 and P2.
b.) OEHHA Chronic Reference Exposure Levels, 2003. na = no available guideline.
c.) 1/40th the 8-hour occupational health guideline (e.g., Cal/OSHA PELs, ACGIH TLVs, DFG MAKs). na = no available guideline.
Note: Samples with no values reported are below the detection limit.

Table 23. Concentrations of individual volatile organic compounds measured indoors and outdoors at P1, P2, and P3 pilot test homes.

**Concentrations of Volatile Organic Compounds (μg/m$^3$)**

| Compound | Detection Limit | P1 Indoors | P1 Indoor Duplicate | P2 Indoors | P1 (P2)[a] Outdoors | P3 Indoors | P3 Outdoors | Indoor Guideline |
|---|---|---|---|---|---|---|---|---|
| 2-Propanone | 4 | 72 | 74 | 36 | | 65 | | 44,500 [c] |
| 2-Propoxyethanol | est. 2 | | | | | | | 2,150 [c] |
| Styrene | 0.4 | 1.0 | 0.9 | 0.6 | | 4.4 | | 900 [b] |
| Tetrachloroethene | 0.4 | | | 0.5 | | | | 35 [b] |
| Toluene | 0.4 | 27 | 28 | 28 | 6.4 | 13 | 3.1 | 300 [b] |
| 1,1,1-Trichloroethane | 0.4 | | | | | | | 1,000 [b] |
| Trichloroethene | 0.4 | | | | | | | 600 [b] |
| 2,2,4-Trimethyl-1,3-pentanediol diisobutyl ether | 2 | | | | | | | na |
| 2,2,4-Trimethyl-1,3-pentanediol monoisobutyl ether, isomer 1 | 0.4 | 1.3 | 1.6 | 2.1 | | 9.7 | | na |
| 2,2,4-Trimethyl-1,3-pentanediol monoisobutyl ether, isomer 3 | 0.4 | 1.5 | 1.4 | 1.7 | | 7.3 | | na |
| 1,2,4-Trimethylbenzene | 0.4 | 2.5 | 2.4 | 1.1 | 1.3 | 16.6 | | 3,125 [c] |
| n-Undecane | 0.4 | | | | | | | na |
| Vinyl acetate | 0.4 | | | | | | | 200 [b] |
| m-,p-xylene | 0.4 | 4.7 | 4.5 | 3.1 | 3.1 | 10.1 | 1.0 | 700 [b] |
| o-xylene | 0.4 | 2.2 | 2.0 | 1.5 | 1.5 | 8.2 | 0.5 | 700 [b] |

a.) Outdoor air sampled at one location, P1, for the two-home cluster of P1 and P2.
b.) OEHHA Chronic Reference Exposure Levels, 2003. na = no available guideline.
c.) 1/40th the 8-hour occupational health guideline (e.g., Cal/OSHA PELs, ACGIH TLVs, DFG MAKs). na = no available guideline.

Note: Samples with no values reported are below the detection limit.

Table 24. Concentrations of formaldehyde and acetaldehyde measured indoors and outdoors at P1, P2, and P3 pilot test homes.

| Concentrations of Formaldehyde and Acetaldehyde Compounds (µg/m$^3$) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Compound | Detection Limit | P1 Indoors | P1 Indoor Duplicate | P2 Indoors | P1 (P2)[a] Outdoors | P3 Indoors | P3 Outdoors | Indoor[b] Guideline |
| Acetaldehyde | 0.4 | 10 | 11 | 6.8 | 3.3 | 17 | 2.2 | 9 |
| Formaldehyde | 0.3 | 26 | 27 | 28 | 1.9 | 45 | 0.8 | 33 |

a.) Outdoor air sampled at one location, P1, for the two-home cluster of P1 and P2.
b.) Acetaldehyde - OEHHA Chronic Reference Exposure Level, 2003. Formaldehyde – California Air Resources Board Indoor Air Quality Guideline, 2005. na = no available guideline.

Table 25. Concentrations of carbon monoxide, nitrogen dioxide, and $PM_{2.5}$ particulate matter measured indoors and outdoors at P1, P2, and P3 pilot test homes.

**Concentrations of Carbon Monoxide, Nitrogen Dioxide, and $PM_{2.5}$ Particulate Matter**

| Compound | Detection Limit | P1 Indoors | P1 Indoor Duplicate | P2 Indoors | P1 (P2)[a] Outdoors | P3 Indoors | P3 Outdoors | Indoor[b] Guideline |
|---|---|---|---|---|---|---|---|---|
| Carbon Monoxide (ppm)<br>- 24-hour average | 0.5 | 0.8 | | | 2.0 | 1.3 | 3.2 | na |
| - maximum eight-hour average | 0.5 | 1.0 | | | 2.9 | 1.4 | 3.8 | 9 |
| - maximum one-hour average | 0.5 | 1.6 | | | 3.3 | 1.8 | 3.9 | 20 |
| Nitrogen Dioxide ($\mu g/m^3$) – 24-hour average | 9 | | | 10 | 12 | | | 150 |
| $PM_{2.5}$ Particulate Matter ($\mu g/m^3$) – 24-hour average | 3.5 | 12 | 17 | 11 | 24 | 11 | 30 | 65 |

a.) Outdoor air sampled at one location, P1, for the two-home cluster of P1 and P2.
b.) California Air Resources Board Indoor Air Quality Guideline, 2005. na = no available guideline.
Note: Samples with no values reported are below the detection limit.

Table 26. Temperature, relative humidity, and carbon dioxide concentrations measured indoors and outdoors at P1, P2, and P3 pilot test homes over a 24-hour period.

**Temperature, Relative Humidity and Carbon Dioxide Concentrations**

| Compound | P1 Indoors | P1 Indoor Duplicate | P2 Indoors | P1 (P2)[a] Outdoors | P3 Indoors | P3 Outdoors | Indoor[b] Guideline |
|---|---|---|---|---|---|---|---|
| Carbon Dioxide (ppm) - 24-hour average | 656 | 678 | 532 | 407 | 620 | 386 | na |
| - maximum | 2,251 | 2,236 | 1,228 | 495 | 1354 | 445 | 700 over outdoors |
| - minimum | 491 | 516 | 421 | 352 | 465 | 373 | na |
| | | | | | | | |
| Temperature (°F) - 24-hour average | 67 | 67 | 68 | 45 | 64 | 49 | na |
| - maximum | 70 | 70 | 73 | 67 | 71 | 63 | na |
| - minimum | 62 | 62 | 67 | 36 | 60 | 44 | na |
| | | | | | | | |
| Relative Humidity (%) - 24-hour average | 42 | 41 | 35 | 70 | 52 | 90 | na |
| - maximum | 48 | 44 | 40 | 28 | 55 | 102 | na |
| - minimum | 40 | 39 | 34 | 93 | 45 | 56 | na |

a.) Outdoor air sampled at one location, P1, for the two-home cluster of P1 and P2.
b.) Carbon dioxide; ASHRAE 62.1-2004, na = no available guideline.

Table 27. Pilot study air sampling flow rate stability for P1, P2, and P3 pilot test homes.

| Air Sampling Flowrate Stability – Relative Standard Deviations [a] | | | |
|---|---|---|---|
| | Minimum | Maximum | Average |
| VOCs (all 12 samples) | 0.00 | 0.23 | 0.08 |
| VOCs (6 analyzed samples- with most stable flow rates) | 0.00 | 0.07 | 0.03 |
| Nitrogen Dioxide (all 6 samples) | 0.01 | 0.05 | 0.03 |
| Formaldehyde/Acetaldehyde (all 6 samples) | 0.02 | 0.54 | 0.11 |
| Formaldehyde/Acetaldehyde (5 samples w/o sample P3-F2) | 0.02 | 0.05 | 0.03 |
| Particulate Matter – $PM_{2.5}$ (all 6 samples) | 0.01 | 0.04 | 0.03 |

a.) Relative standard deviations, calculated as the standard deviation divided by the average of each pair of air sampling flow rate measurements (i.e., start and stop flow rate measurements).

Table 28. Pilot study carbon dioxide and carbon monoxide calibration stability for P1, P2, and P3 pilot test homes.

| Carbon Monoxide and Carbon Dioxide Calibration Stability (ppm) [a] | | | |
|---|---|---|---|
| | Minimum | Maximum | Average |
| Carbon Monoxide Zero - 0 ppm (all 6 samples – 24-hour collection periods) | 0 | 0 | 0 |
| Carbon Monoxide Span - 35 ppm (six 24-hour collection periods) | -3 | 1 | -1 |
| Carbon Dioxide Zero - 0 ppm (six 24-hour collection periods) | 0 | 63 | 21 |
| Carbon Dioxide Span - 1000 ppm (six 24-hour collection periods) | -16 | 120 | 39 |
| Carbon Dioxide Span - 1000 ppm (5 samples w/o sample P3-C2) | -16 | 60 | 22 |

a.) Calibration stability calculated as the difference between the post-calibration concentration check and the calibration gas concentration.

Table 29. Pilot study air contaminant measurement precision for volatile organic compounds at P1, P2, and P3 pilot test homes.

**Air Contaminant Measurement Precision**

| | Sample 1 (μg/m$^3$) | Sample 2 Duplicate Sample (μg/m$^3$) | Relative Standard Deviation [a] |
|---|---|---|---|
| Acetic acid | 0.8 | 0.7 | 0.09 |
| Acetonitrile | 3.6 | 4.0 | 0.07 |
| Acetophenone | 3.7 | 3.8 | 0.02 |
| Benzaldehyde | 4.6 | 4.9 | 0.04 |
| Benzene | bql | bql | na |
| 1-Butanol | 4.0 | 4.1 | 0.02 |
| 2-Butanone | 4.4 | 4.5 | 0.02 |
| 2-Butoxyethanol | bql | bql | na |
| tert-Butyl methyl ether | bql | bql | na |
| Caprolactam | bql | bql | na |
| Carbon tetrachloride | bql | bql | na |
| Chloroform | 7.0 | 7.3 | 0.03 |
| Cresol mix | bql | bql | na |
| Cyclohexane | bql | bql | na |
| Decanal | bql | bql | na |
| n-Decane | bql | bql | na |
| Di(ethylene glycol)butyl ether | bql | bql | na |
| 1,4-Dichlorobenzene | bql | bql | na |
| 1,1-Dichloroethene | 1,173 | 1,181 | 0.00 |
| n-Dodecane | bql | bql | na |
| Ethanol | bql | bql | na |
| Ethoxyethanol | 2.2 | 2.1 | 0.03 |
| 2-Ethoxyethyl acetate | bql | 0.9 | na |
| Ethyl acetate | 2.1 | 1.9 | 0.07 |
| 2-Ethyl-1-hexanol | 14 | 14 | 0.00 |
| Ethylbenzene | 1.4 | 1.4 | 0.00 |
| Ethylene glycol | 0.6 | 0.6 | 0.00 |
| 2-Furancarboxaldehyde | bql | bql | na |
| Heptanal | 10 | 9.8 | 0.01 |
| n-Heptane | 0.8 | 0.7 | 0.09 |
| Hexanal | 3.6 | 4.0 | 0.07 |

a.) Relative standard deviation calculated as the standard deviation divided by the average for each pair of duplicate 24-hour samples. na = not applicable for sample pairs with one of samples below quantification limit (bql).

Table 30. Pilot study air contaminant measurement precision for volatile organic compounds at P1, P2, and P3 pilot test homes.

**Air Contaminant Measurement Precision**

| | Sample 1 (μg/m$^3$) | Sample 2 Duplicate Sample (μg/m$^3$) | Relative [a] Standard Deviation |
|---|---|---|---|
| n-Hexane | 3.8 | 3.9 | 0.02 |
| d-Limonene | 25 | 19 | 0.19 |
| 1-Methoxy-2-propanol | bql | bql | na |
| 2-Methoxyethanol | bql | bql | na |
| 2-Methoxyethyl acetate | bql | bql | na |
| 4-Methyl-2-pentanone (MIBK) | 0.5 | 0.5 | 0.00 |
| 1-Methyl-2-pyrrolidinone | bql | bql | na |
| Naphthalene | bql | bql | na |
| Nonanal | bql | 5.2 | na |
| Octanal | bql | bql | na |
| Pentanal | 8.2 | 7.9 | 0.03 |
| Phenol | bql | bql | na |
| alpha-Pinene | 13 | 14 | 0.05 |
| beta-Pinene | 3.0 | 3.1 | 0.02 |
| 2-Propanol | 146 | 149 | 0.01 |
| 2-Propanone | 72 | 74 | 0.02 |
| 2-Propoxyethanol | bql | bql | na |
| Styrene | 1.0 | 0.9 | 0.07 |
| Tetrachloroethene | bql | bql | na |
| Toluene | 27 | 28 | 0.03 |
| 1,1,1-Trichloroethane | bql | bql | na |
| Trichloroethene | bql | bql | na |
| 2,2,4-Trimethyl-1,3-pentanediol diisobutyl ether | bql | bql | na |
| 2,2,4-Trimethyl-1,3-pentanediol monoisobutyl ether, isomer 1 | 1.3 | 1.6 | 0.15 |
| 2,2,4-Trimethyl-1,3-pentanediol monoisobutyl ether, isomer 3 | 1.5 | 1.4 | 0.05 |
| 1,2,4-Trimethylbenzene | 2.5 | 2.4 | 0.03 |
| n-Undecane | bql | bql | na |
| Vinyl acetate | bql | bql | na |
| m-,p-xylene | 4.7 | 4.5 | 0.03 |
| o-xylene | 2.2 | 2.0 | 0.07 |

a.) Relative standard deviation calculated as the standard deviation divided by the average for each pair of duplicate 24-hour samples. na = not applicable for sample pairs with one of samples below quantification limit (bql).

Table 31. Pilot study air contaminant measurement precision for acetaldehyde, carbon dioxide, carbon monoxide, formaldehyde, nitrogen dioxide, and particulate matter $PM_{2.5}$ at P1, P2, and P3 pilot test homes.

**Air Contaminant Measurement Precision**

| | Sample 1 | Sample 1 Duplicate | Relative Standard Deviation [a] |
|---|---|---|---|
| Acetaldehyde ($\mu g/m^3$) | 10 | 11 | 0.07 |
| Formaldehyde ($\mu g/m^3$) | 26 | 27 | 0.03 |
| Carbon Dioxide (ppm) | 626 | 678 | 0.06 |
| Carbon Monoxide (ppm) | 0.8 | bql | na |
| Nitrogen Dioxide ($\mu g/m^3$) | bql | bql | na |
| Particulate Matter – $PM_{2.5}$ ($\mu g/m^3$) | 12 | 17 | 0.24 |

a.) Relative standard deviation calculated as the standard deviation divided by the average for each pair of duplicate 24-hour samples. na = not applicable for sample pairs with one of samples below quantification limit (bql).

Table 32. PFT measurement precision for P1, P2, and P3 Pilot test homes.

**PFT Measurement Precision**

| | Sample 1 | Sample 1 Duplicate Sample | Relative [a] Standard Deviation |
|---|---|---|---|
| Pilot Home 1 | | | |
| Indoor Tracer short term, PMCH (ach) | 0.37 | 0.37 | 0.00 |
| Garage Tracer, short term, p-PDCH (%) | 2.6 | 1.9 | 0.20 |
| Pilot Home 2 | | | |
| Indoor Tracer short term, PMCH (ach) | 0.73 | 0.71 | 0.03 |
| Garage Tracer, short term, p-PDCH (%) | 10.1 | 11.9 | 0.11 |
| Pilot Home 3 | | | |
| Indoor Tracer long term, PMCH (ach) | 0.30 | 0.34 | 0.09 |
| Garage Tracer, long term, p-PDCH (%) | 11.3 | 11.4 | 0.01 |

a.) Relative standard deviation calculated as the standard deviation divided by the average for each pair of duplicate 24-hour samples.

Figure 1. Pilot Home P3, photograph of air sampling rig in the family room.

Figure 2. Close-up of air sampling rig.

Figure 3. Close-up of air sampling rig with outdoor radiation/rain shield.

Figure 4. Pilot Home P2, Duct Blaster installed at return air inlet of forced air heating/cooling system.

Figure 5. Pilot Home P2, Blower Door and APT installed.

Figure 6. Pilot Home P1, photograph of front elevation.

Figure 7. Pilot Home P2, photograph of front elevation.

Figure 8. Pilot Home P3, photograph of front elevation.

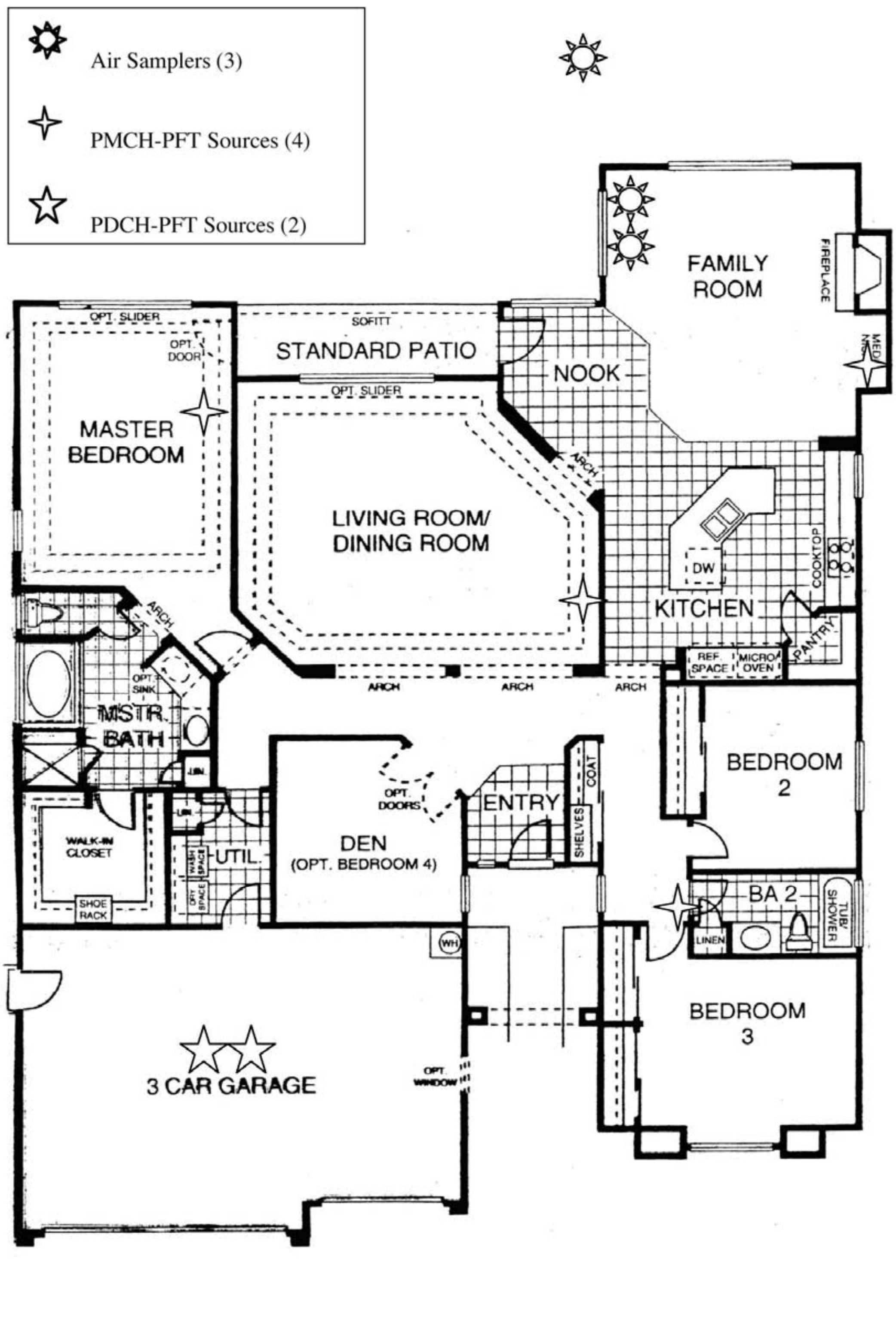


Figure 9. Floor plan of Home P1 depicting the locations of the air samplers and the PFT sources.

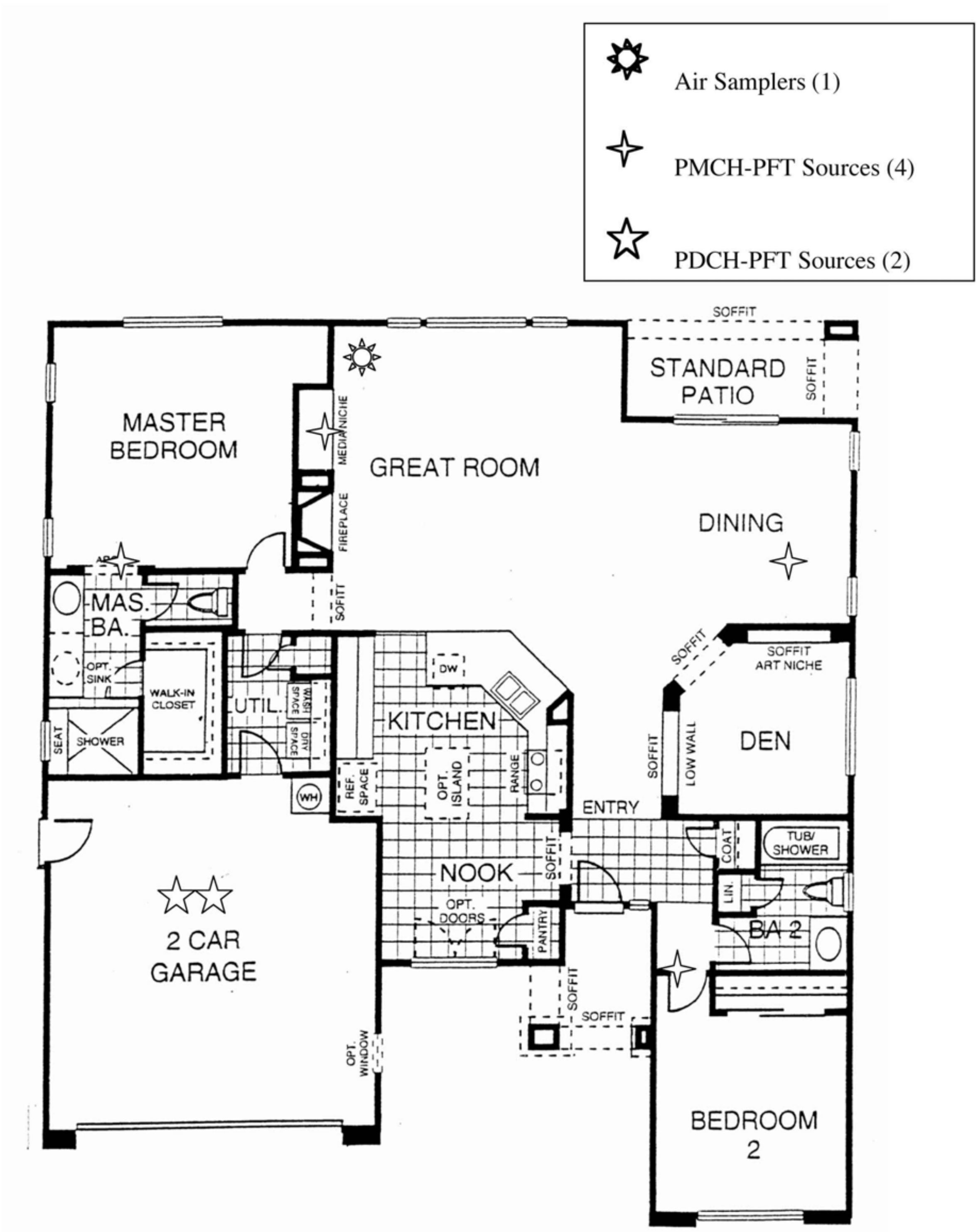


Figure 10. Floor plan of P2 depicting the locations of the air samplers and the PFT sources.

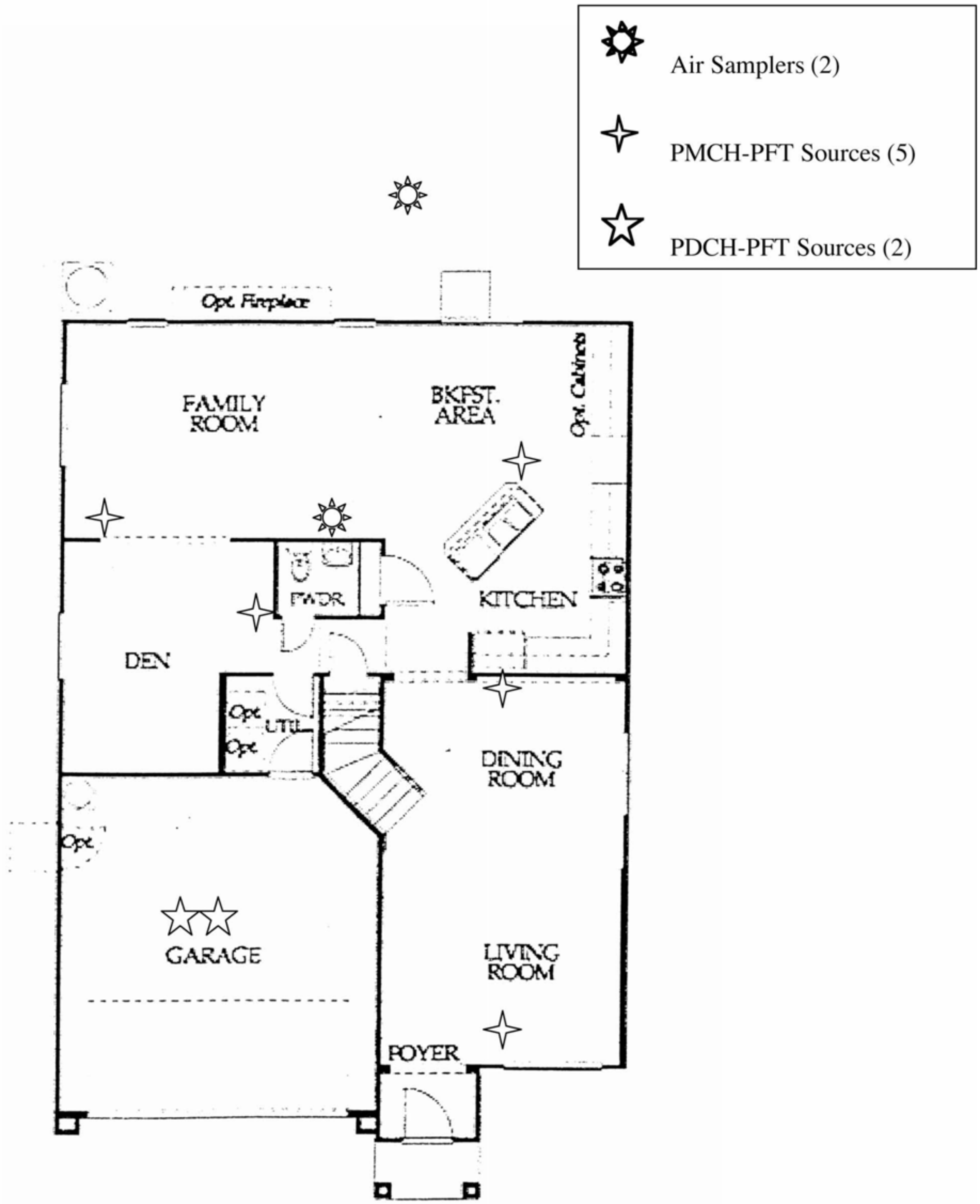


Figure 11. Floor plan of P3 first floor, depicting the locations of the air samplers and the PFT sources.

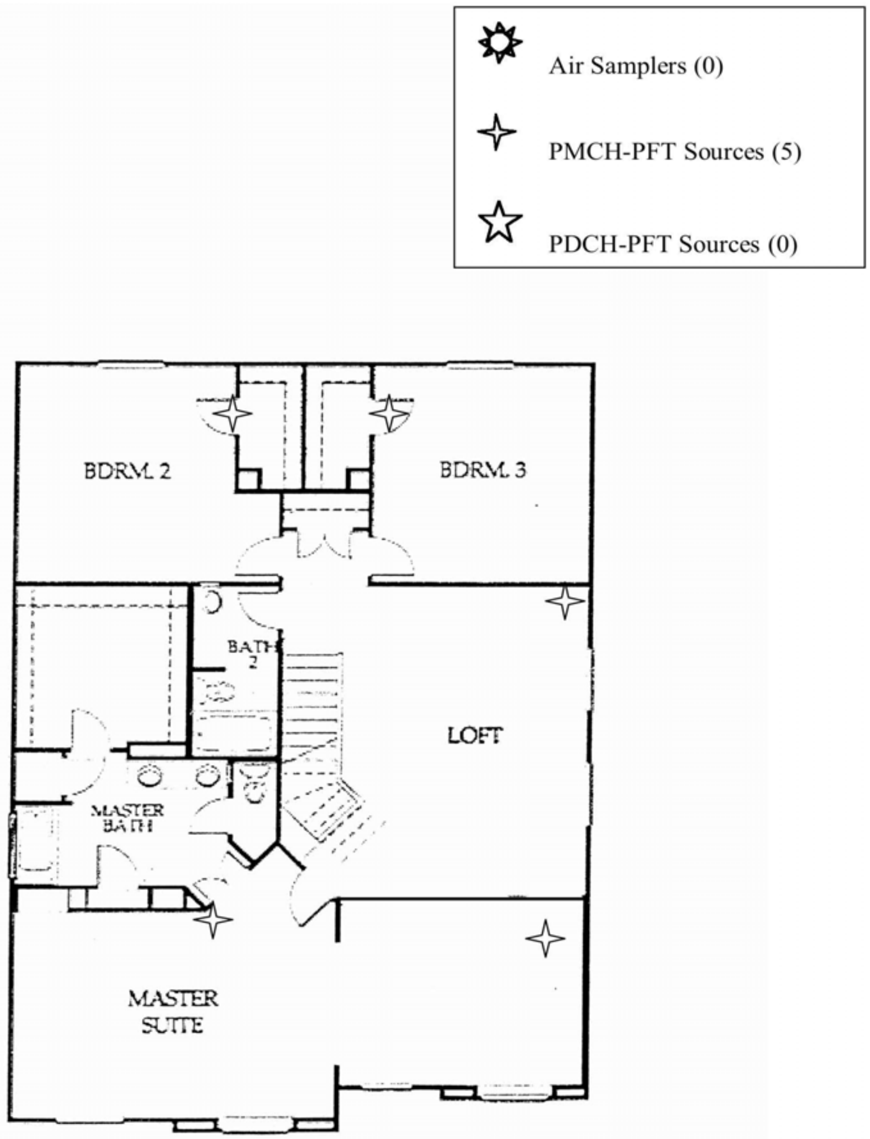


Figure 12. Floor plan of P3 second floor, depicting the locations of the PFT sources.

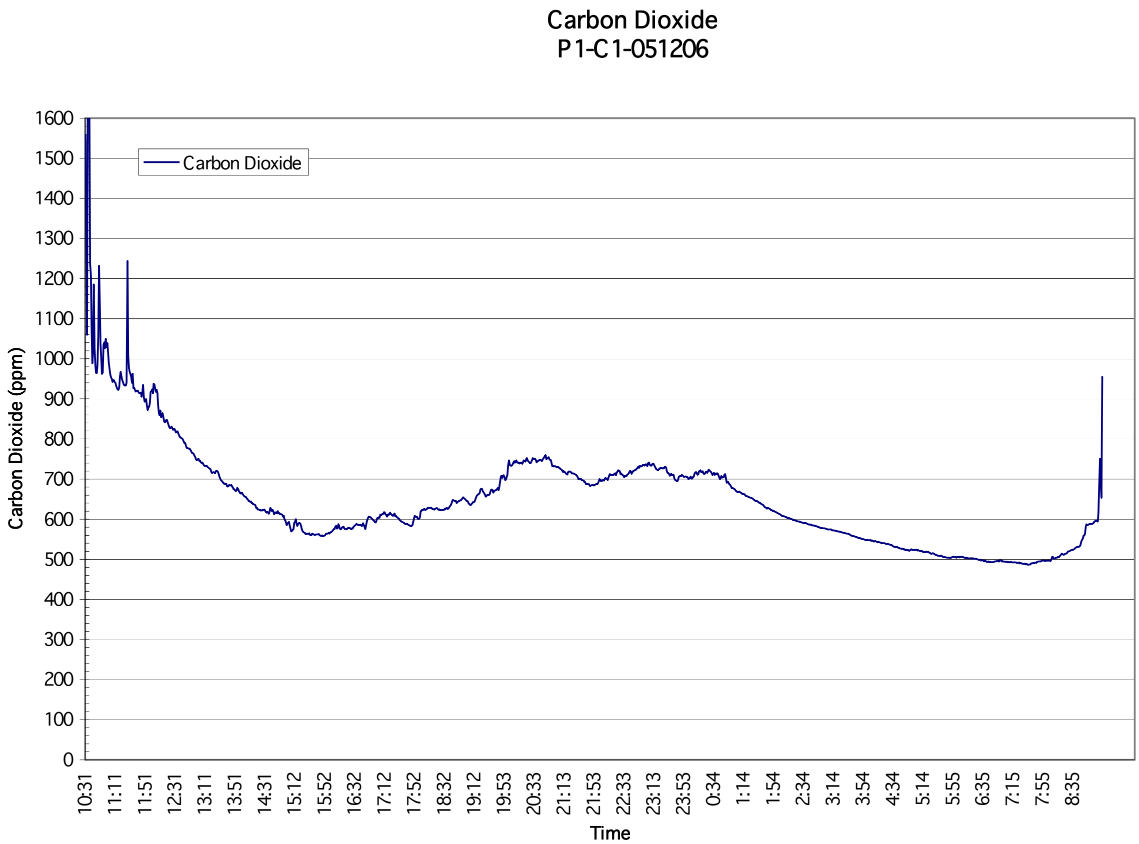


Figure 13. Concentration of carbon dioxide measured indoors at one-minute intervals in pilot home P1 between 10:19 on December 6, 2005, and 9:22 on December 7, 2005.

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# Appendix A

## Pilot Study

### Recruitment Letter

# State of California

**Governor Arnold Schwarzenegger**

**California Energy Commission**

<<Customer Name>>
<<Address>>
<<City>>, <<CA>>, <<Zip code>>

November 8, 2005

Dear <<Customer Name>>,

**SUBJECT: Energy, Ventilation, and Indoor Air Quality Study**

Thank you again for completing the UC Berkeley Ventilation Practices and Indoor Air Quality Survey sent to you in 2004–2005. As you may recall, this important research is sponsored by the California Energy Commission and the California Air Resources Board (ARB) to help improve the energy efficiency and indoor air quality of newer homes in California. In the Survey, you expressed interest in participating in the second part of the study, which involves measuring ventilation and indoor air quality in new homes.

We are contacting you to request your participation in the second part of the study, entitled "Ventilation and Indoor Air Quality in New Homes." Your home was randomly selected for this study, and receipt of this letter does not mean there is a problem with ventilation or indoor air quality in your home. Because your home was randomly selected to obtain a representative group of homes, your participation is critical to the success of this study. In addition, your participation is very important to the State of California as it prepares to update building energy design standards and strives to assure healthful indoor air quality in our new homes.

**<u>What Do I Receive for My Participation?</u>**
The ARB is offering to thoroughly measure the ventilation and indoor air quality of your home at no cost to you. This type of air quality testing would typically cost as much as $7,000 per home. We recognize that your participation in this study may present an inconvenience to you, so we are pleased to offer you $100 to thank you for your participation in this research.

All test results and personal information about your home will be kept strictly confidential. You will receive a summary of the final report for the study and be notified when the final report is available on the internet. The final report will include a description of the measurements and the collective results of the 100 homes tested. For your home, test results will be available upon your request. This information can be used to improve the energy efficiency and air quality of your home.

**<u>What Does the Study Involve?</u>**
- ✓ We ask that you conduct your normal household activities during the testing period.
- ✓ Field teams will visit your home on 3 days within an 8–10 day period.

  - Each visit will last approximately 2–3 hours. Each visit will be scheduled with you and will occur between 9 a.m. and 7 p.m. The teams may also need to inspect your home's attic or crawlspace.
  - Team members will be fully bonded and will wear identification badges.
  - If you would like to participate but believe you won't be able to accommodate each visit, a key lockbox can be provided.
- ✓ A field team will place small data loggers (matchbox sized) in a few windows and ventilation fans to collect usage information (Days 1–8). These data loggers will not interfere with opening, closing, or locking your windows.
- ✓ You will be provided with forms to track your:
  - Household window and fan usage for 1 week (Days 1–8).
  - Household activities such as cooking, painting, candle burning, smoking, and vacuuming for a 2-day period (Days 7–8).
- ✓ You will be asked to complete a brief ventilation and indoor air quality questionnaire.
- ✓ A field team will install air quality testing equipment in your home's main living area on Day 7. The equipment will operate for a 22–26 hour period (see the photo below); it is very quiet and safe.
- ✓ A field team will remove the data loggers and testing equipment on Day 8.

A more detailed description of the in-home visits will be provided when you schedule an appointment.

**<u>How Do I Enroll in the Study?</u>**

We hope that you will agree to participate in this study. **To enroll or obtain additional information, please call Bud Offermann at this toll-free number, 1-888-567-7700, by November 15, 2005.**

Thank you for your consideration.
Sincerely,

Francis "Bud" Offermann
Under ARB Contract No. 04-310
Administrator of Research Recruitment
Indoor Environmental Engineering
1448 Pine St., Suite103
San Francisco, CA 94109
www.IEE-SF.com
**1-888-567-7700**

Thomas J. Phillips, Contract Manager
Indoor Exposure Assessment Section
Research Division
California Air Resources Board
1001 - I St., POB 2815
Sacramento, CA 95812
www.arb.ca.gov/research/indoor/indoor.htm
916-322-7145

Quiet indoor air sampler, typically installed in the living room for a 22 - 26 hour period.

# Appendix B

## Pilot Study

### Recruitment Script

Air Resource Board Ventilation & Indoor Air Quality Study

# Recruiting Instrument

**Recruiting ID:________** **Initial Mailing: Pilot Mailing, November 9, 2005**

**Initial Contact Information (collect at start of call)**

***Participant Name (if different than database)*:________________________________________**

***Home Address (if different than database)*:____________________________________________**

***Phone-Home*: __________________________**

**Additional Contact Information (collect at end of call)**

**Name and e-mail:_______________________ Name and e-mail:_______________________**

**_______________________ _______________________**

***Name and Phone-Work*: _________________ *Name and Phone-Work*: _________________**

**_________________ _________________**

***Name and Phone-Cell:* __________________ *Name and Phone-Cell*: __________________**

**__________________ __________________**

**Circle best number and time to call: ____________________________________**

## Call Log

**Codes:**

1=Completed and agrees to participate 2=Callback 3=Left Message
4=Busy 5=No Answer 6=Refusal
7=Termination 8=Wrong Number 9=Disconnected Number

10=Language Barrier

| | Date: | Time: | | Outcome | Notes |
|---|---|---|---|---|---|
| Call 1 | / | : | AM PM | | |
| Call 2 | / | : | AM PM | | |
| Call 3 | / | : | AM PM | | |
| Call 4 | / | : | AM PM | | |
| Call 5 | / | : | AM PM | | |
| Call 6 | / | : | AM PM | | |
| Call 7 | / | : | AM PM | | |

**<u>Concerned Customers:</u>** Customers may call the California Air Resources Board to confirm the validity of our study. Contact Thomas J. Phillips, Contract Manager at 916.322.7145.
Additional information on indoor air quality is available on the web at http://www.arb.ca.gov/research/indoor/indoor.htm and http://www.arb.ca.gov/research/research.htm.

INTRODUCTION:

Hello this is Bud Offermann. I am the Principle Investigator for the California Air Resources Board Research Project "Ventilation and Indoor Air Quality in New Homes". **Are you interested in finding more about this research project and perhaps participating ??**

*Yes. Great ! First let me confirm your name, address, and phone number.* ***Enter information on page 1, Initial Contact Information.***

No. Well then how can I help you ?

*<u>Notes from homeowner</u>*:

Or (if Bud is not in)

Hello, Mr. Offermann is not available at this time. My name is Jonathan Robertson and I am the field team manager for the California Air Resources Board Research Project "Ventilation and Indoor Air Quality in New Homes". **Are you interested in finding more about this research project and perhaps participating ?**

*Yes. Great ! First let me confirm your name, address, and phone number.* ***Enter information on page 1, Initial Contact Information.***

No. Well then how can I help you ?

*<u>Notes from homeowner</u>*:

LOG in call start time:___________ LOG in call stop time:_____________
*I first need to ask you a few questions to confirm that your home qualifies for the study.*

*QUALIFIER QUESTIONS*

1. **Are you the original owner?**
   1. Yes
   2. No I am the $2^{nd}$, $3^{rd}$, $4^{th}$ owner. (Circle, which one applies)
   3. No, I am a renter. Thank and terminate call (explain that this study is only open to owner occupied homes)

2. **How long have you lived at this house ?**

   Months______ / Years_______

   If less than one year by the time that the field study is to be scheduled then terminate call (this study is only open to owners who have lived in there house for more than one year).

3. **Is this your primary residence?**
   1. Yes
   2 No. Thank and terminate call (this study is only open to the primary residences of owner occupied homes)

4. **Can you tell me if your home was constructed before or after 2002?**
   1. Yes, built before 2002. (Thank and terminate call, this study is only open to the new homes built after 2002)
   2. No, built after 2002. (Proceed)
   98. Don't Know. Ask who might know; ____________________________

5. **Do you recall the month and year your home was completed?**
   Month/Year: ____________________
   Not sure, estimate: _______________

6. **Has your home had any major fire, smoke, or water damage?**
   1. Describe what and when:___________________________________
   __________________________________________________________
   __________________________________________________________

   2. No.

7. I need to find out if your home has a fresh air ventilation system. Typically these system have an air duct connected to your forced air heating and cooling system to bring in outdoor air. Or some fresh air systems have a separate fan and ductwork that distributes air continuously throughout the house. A whole house exhaust fan that is used to cool the house at night does <u>not</u> qualify. **Does your home have a <u>fresh air ventilation system</u> ?**

1. Yes
2. Not sure
3. No
98. Don't Know

**8. If yes, is the system operational ?**
1. Yes
2. Not sure
3. No
98. Don't Know

**9. If yes, do you run the fan for this system continuously or most of the time when the house is occupied?**
1. Yes
2. Not sure
3. No
98. Don't Know

***Great! It appears that your home will qualify for the study.***

***I'd like to go over the details of our visits, and make sure you understand what participants must do.***

**10.** We are requesting permission to conduct ventilation and indoor air quality tests in your home. There would be three home visits over an 8-day period (e.g., one visit each on days 1, 7 and 8. Each visit would require approximately 2–3 hours and will be scheduled with you to occur between 9 a.m. and 7 p.m. (e.g., 9–12, or 1–4, or 4–7). **Would you be willing to accommodate us with this request?**
1. Yes, (skip Q11)
2. Not sure, depends on the hours go to Q11.
3. Not sure, Have other concerns or questions. Go to Participant FAQ.
4. No, ask why and go to Q11 unless homeowner terminates call.

*Notes from homeowner* Comments or concerns:

**11.** To facilitate the scheduling of these three home tests, we can offer you the option of a lock box. By utilizing the lockbox, you don't have to be home for the entire visit or for all of the visits. **Would you be interested in getting a lockbox?**
1. Yes, (provide more information ask about getting a lock box)
2. Not sure, (provide more information on how it works)
3. No, thank and terminate call if also no to **Q.10**

### *FIRST HOME VISIT*

**12.** Each visit to your home has a unique purpose. During the first visit we would like to view a copy of the floor plan. **Do you have a copy of the floor plan and the homeowner's package?** It may have been included in the homeowner's package.

1. Yes, I have both a floorplan and a homeowner's package. (Ask for them to pull it out for first visit and we'll be borrowing it to be returned the following visit).
2. Yes, I have homeowners package but don't know if there is a floor plan, but I will check and call you back. (Inform them if we don't get your floor plan, then we will need to make a sketch of the location and size of each room.)
3. No, I don't have the homeowner's package but I have a floor plan.
4. No, I don't have either. (Inform them we will need to make a sketch of the location and size of each room.)

**13.** The primary purpose of the first home visit is to install the small data loggers that collect information on window and fan usage. The small matchbox sized dataloggers are placed on selected windows and will not interfere with your opening, closing or locking your windows. A few dataloggers will also be placed on ventilation system fan motors**. Would you agree these data loggers to be installed in your home?**

1. Yes
2. Not Sure, (Describe in greater detail nature and location of loggers).
3. No, terminate and inquire as to why.

*Notes from homeowner* Comments or concerns:

**14.** During this visit our technicians will also provide with a short questionnaire and log sheets to log your window and fan usage and indoor activities such as cooking. We ask you to complete these befor5e the last visit on day 8. **Will you have time to complete the questionnaire and log sheets?**

1. Yes
2. Not Sure, (Explain what to expect.)
3. No, terminate and inquire as to why.

*Notes from homeowner* Comments or concerns:

### *SECOND HOME VISIT*

A week later, we would make our second visit. During this visit our technicians will be installing an air sampler which quietly measures the air quality in your home. The air sampler is quiet, childproof, and pet-proof. You may recall having seen a photo of the air sampler in the letter. **Would you agree to allow the air sampler(s) in your home for 24 hours?**

1. Yes
2. Not Sure (Explain what to expect.)
3. No, terminate and inquire as to why.

*Notes from homeowner* Comments or concerns:

**15.** During the second home visit, we will also need to access the ventilation system and collect data on the house characteristics. This work requires inspecting the attic spaces and or crawlspaces. **Would you agree to allow us to inspect the ventilation system, and attic and crawlspaces?**

1. Yes
2. Not Sure (Explain what to expect.)
3. No, terminate and inquire as to why.

*Notes from homeowner* Comments or concerns:

**16. Is your ventilation equipment in the attic or the crawlspace?**

1. Attic
2. Crawlspace
3. Garage
4. Indoor closet space
5. Not Sure

**17. On a typical weekday, how many adults and children can be expected to be in the home at sometime during daytime hours (9 a.m. - 5 p.m.)**?

Number of adults: ______
Number of children: ______

*THIRD HOME VISIT*

**18.** The third and last visit will need to occur approximately 24 hours after the previous appointment. The purpose of this visit is to shut down and retrieve the air sampler, and to collect the data loggers. Again, we can provide you with a lock box to facilitate this scheduling if you wish. **Will you be able to accommodate our request to return approximately 24 hours later?**

1. Yes
2. Not Sure (Explain what to expect.)
3. No, terminate and inquire as to why.

***Notes from homeowner* Comments or concerns:**

**19.** During the third visit, we need to determine how airtight your home is by conducting a building envelope leakage test. All doors and windows will be closed and a special fan will be temporarily installed on one door that will remain open. The fan runs for approximately 10–15 minutes and is used to measure airflow. **Would you agree to allow the leakage testing of your building?**

1. Yes
2. Not Sure (Explain what to expect.)
3. No, terminate and inquire as to why.

*Notes from homeowner* Comments or concerns:

**20.** A similar test will be run on the home's ventilation system to see how airtight the ducts are. This test runs for about five to ten minutes. **Would you agree to allow the duct leakage testing?**

1. Yes
2. Not sure (Explain what to expect).
3. No, terminate and inquire as to why.

*Notes from homeowner* Comments or concerns:

Lastly, our technicians will collect the questionnaires and log sheets and provide you with a $100 money order to thank you for participating.

**21. Do you have any additional questions or concerns that we have not addressed already?**

1. Yes
2. No

*Notes from homeowner* Comments or concerns:

**22. Would you like to participate?**

1. Yes
2. No. Ask why not and terminate.

*Notes from homeowner* :

**23.** If yes on Q22 then "GREAT". **Can we take a minute to discuss the scheduling of the three home inspections?**

1. Yes
2. No. If no, then when, with whom, and at what number can we discuss the scheduling.

*Notes from homeowner*

## SCHEDULING QUESTIONS

**24.** We currently are looking to schedule three homes for inspections to be conducted between November 29 through December 8. **Do either of the following sets of three dates work for you, with or without a lock box ?**

**Set 1.** **Home Visit 1: Tuesday, November 29**
Home Visit 2: Tuesday, December 6
Home Visit 3: Wednesday, December 7

Set 2. Home Visit 1: Wednesday, November 30,
Home Visit 2: Wednesday, December 7
Home Visit 3: Thursday, December 8

1. Either Set ______
2. Set 1 Only______
3. Set 2 Only______

**25.** If yes to Q24 skip to Q26.
If no to Q24. **Would you be interested in possibly participating in any of the future study periods ?** Circle periods of interest.

- Spring, April, 2006
- Summer, July/August, 2006
- Winter, January/February, 2007

3. Is there a preference ? ________________________________________

**26.** If yes to Q24. **Do any of the following 2–3 hour time periods for the three home visits work for you, with or without a lock box ?**

1. 9AM to 12PM

2. 1PM to 4PM

3. 4PM to 7PM

4. Is there a preference, $1^{st}$ or $2^{nd}$? ___________________________

*Notes from homeowner*

*Excellent. We will be calling you back very shortly to confirm the exact dates and times of the inspections. Do you have any further questions at this time ?*
*Notes from homeowner* :

Finally, since the ventilation and indoor air quality factors can vary from season to season we will be asking a few residences to participate in a second set of inspections in a different season than the first set. These homeowners will receive an additional $100 for participating in a second set of inspections. **Provided the first set of inspections went smoothly for you, would you consider participating in a second set ?**

1. Yes
2. No. If no ask why not.

*Notes from homeowner*

**Can you please provide us with some additional contact information to facilitate future communications ? Get additional contact information and log in on page 1.**

**Thank you for taking this time to discuss your participation in the important research project.**

**!!!!! Log in on page 2 the time of the end of the call. !!!!!**

# Appendix B

## Volatile Organic Compound Analytical Method

## Analytical Methods

### *VOC Sorbent Tubes*

The multi-sorbent samplers used in this study contained Tenax®-TA 60/80 mesh backed up by a section of a carbonaceous sorbent, Carbosieve™ S-III 60/80 mesh (Part No. 10184, Supelco, Inc.). These sorbents were packed in series within a 10-centimeter (cm) long by 0.64-cm OD stainless steel tube passivated with a Silcosteel® coating (Custom order, Supelco, Inc.). The sorbent samplers were conditioned in the laboratory prior to shipment. For conditioning, batches of 20 samplers were heated at 300$^{o}$C for 30 or more minutes with helium purge flow. One sampler out of every batch was analyzed. This analysis demonstrated that the background levels of target VOCs in conditioned samplers were below 2 ng/sampler and the levels of summed VOCs were below 10 ng/sampler.

### *GC/MS Analysis of VOCs*

The thermal desorption – gas chromatography/mass spectrometry (GC/MS) method used for the analysis of VOCs is based on U.S. EPA Method TO-17, "Determination of Volatile Organic Compounds in Ambient Air Using Active Sampling onto Sorbent Tubes" (U.S. EPA 1999).

Prior to analysis, the sorbent samplers were purged at room temperature for 30 minutes with helium flowing at 100 cubic centimeters per minute (cm$^3$/min). Then, a gaseous internal standard (ISTD) was added to each sampler using a loading rig fitted with a calibrated sampling loop and additional helium flow was passed through the tube for three minutes. The ISTD was 191 nanograms (ng) of 1-bromo-4-fluorobenzene (BFB) supplied as a certified gas mixture (14.9 ppm ±2%, balance nitrogen; Scott Specialty Gases). The ISTD was used to check on the operation of the system, to provide a retention-time marker, and to enable quantitative analysis.

The sorbent samplers were thermally desorbed (UltrA TD-UNITY, Markes International, Ltd.) and introduced into a GC/MS system (Models 6890 GC/5973 MSD, Agilent). The GC was fitted with a 30-m, 0.25- millimeter (mm) ID, 1-micron (µm) film moderately polar column (Model DB-1701, Part No. 122-0733; Agilent). The MS detector was operated in the SCAN mode over a mass range of *m/z* 30–450 amu. The samples were split during the injection phase of the analysis. For this study, the split ratio was 5:1. The thermal desorption, GC, and MS conditions for the analyses are summarized in Tables 1–3, respectively.

### *Low-Molecular Weight Carbonyl Sampling and Analysis*

The methods used for the sampling and analysis of formaldehyde and acetaldehyde are based on ASTM D 5197-03, “Standard Test Method for Determination of Formaldehyde and Other Carbonyl Compounds in Air (Active Sampler Methodology” (ASTM 2003).

Sep-Pak XPoSure Aldehyde Samplers (Part number WAT047205, Waters, Corp.) were used to collect air samples for formaldehyde and acetaldehyde. When air is pulled through a sampler, the acidified 2,4-dinitrophenylhydrazine (DNPH) reagent in the sampler reacts with carbonyl compounds to form the stable hydrazone derivatives that are retained by the sampler. In the laboratory, the hydrazone derivatives were eluted from each sampler with 2 milliliter (mL) acetonitrile. An aliquot of a sample was analyzed for the hydrazone derivatives of formaldehyde and acetaldehyde using reverse-phase high-performance liquid chromatography (HPLC) with ultraviolet (UV) detection (Model 1050, Hewlett-Packard). The absorbance of the derivatives was measured at 360 nm. The HPLC conditions for the analyses are summarized in Table 4.

### *Sampler Storage*

Upon arrival at the laboratory, all samplers were logged, checked for integrity, and transferred to a freezer dedicated to sample storage. VOC samples were analyzed within one week of receipt. Aldehyde samples were analyzed within approximately four weeks of receipt.

## Calibrations

### *VOCs*

Two custom calibration mixtures for the analysis of VOCs were prepared by Absolute Standards, Inc. These mixtures were accompanied by certified weight reports containing all of the necessary data for ISO-17025 compliance. One calibration mixture contained 20 target VOCs. It was prepared in methanol. The other mixture contained vinyl acetate only and was prepared in water. The compounds and their assigned concentrations in the mixtures based on the weight measurements are listed in Table 5. The uncertainty for each compound was less than 0.5%.

Calibration standards for VOCs were prepared in the laboratory by diluting the vinyl acetate mixture and the 20-component mixture as described below. Problems encountered with the analysis of vinyl acetate, n-hexane, and ethylene glycol in the first VOC external proficiency test (see below) led us to prepare additional standards. Subsequently, the standard for the 20-component mixture was prepared without the addition of vinyl acetate. A standard for ethylene glycol was prepared individually in methanol, and a gas standard containing vinyl acetate and n-hexane also was prepared.

Two working standards of the 20-component mixture with and without vinyl acetate were prepared by dilution of the stock solution(s) in methanol. The high standard was a 1:20 dilution of the 20-component mixture (1:200 of the vinyl acetate mixture) resulting in VOC concentrations of 100 µg/mL (100 ng/µL). The low standard was a 1:100 dilution of the 20-component mixture (1:1000 of the vinyl acetate mixture) resulting in concentrations of 20 µg/mL (20 ng/µL). A single working standard of ethylene glycol in methanol was prepared in the laboratory from the pure compound (Part. No. 32,455–8, 99+%; Aldrich Chemical Co.). The concentration was 111 µg/mL (111 ng/µL).

Aliquots of the working standards of the 20-component mixture with and without vinyl acetate were spiked onto multi-sorbent tubes using an Adsorbent Tube Injector System (ATIS, Supelco, Inc.). The aliquots were transferred to the ATIS with modified microliter syringes (7000 Series, Hamilton Co.). The ATIS flash vaporized the compounds into a continuous flow of helium gas that swept the compounds onto the tube. The ATIS parameters were $100^{o}C$ with 50 $cm^3/min$ flow rate. Multi-sorbent tubes spiked with the different levels of VOCs were analyzed by the same method used for the analysis of the field samples.

The ATIS spiking method did not work adequately for ethylene glycol. Instead, microliter aliquots of the ethylene glycol working solution were spiked directly into the inlet of sorbent tubes containing Tenax TA only.

A gas standard was prepared for n-hexane and vinyl acetate in a static dilution bulb (SDB) following the method described in TO-1 (U.S. EPA 1984) using pure compounds (Part No. 13,938–6, 99+% and Part No. V150-3, 99+%, respectively; Aldrich Chemical Co.). Five microliters of each chemical were added to a SDB, producing gas concentrations of 1.66 and 2.35 ng/µL for n-hexane and vinyl acetate, respectively. Known volumes of gas (25 to 200 µL) were withdrawn from the SDB using a gas-tight syringe with locking mechanism and injected onto sorbent tubes to create the calibration levels.

Three full calibrations were produced for the multi-component mixture. Each of these consisted of six or more concentration levels. The masses of the individual VOCs ranged from 20 to 500 ng. Two calibrations were generated during the analysis of field samples collected from August to October 2006, and one calibration was generated during the analysis of samples collected from January to March 2007. The variation in the linear term over this period was 9% relative standard deviation (RSD), or better, with the exception of caprolactam, which had a RSD of 15%.

Two calibrations were produced for ethylene glycol, one for the analysis of samples from each of the two field collection periods. These contained three concentration levels over a range of 78 to 222 ng. The linear terms were nearly identical; however, the second calibration had a large negative intercept equivalent to 57 ng of ethylene glycol. A single calibration, consisting of five concentration levels, was generated for n-hexane and vinyl acetate.

All calibrations were produced using the internal standard method. For each compound, one extracted ion served as the quantitative ion and one to two other extracted ions were used as qualifiers. The quantitative ion for the internal standard (ISTD), 1-bromo-4-fluorobenzene, was m/z 95. The ISTD also served as a time reference for each calibration. All retention times of the individual VOCs relative to the retention time of the ISTD were stable throughout the study. Two xylene isomers, m-xylene and p-xylene, co-elute and were treated as a single compound (termed m/p-xylene). The calibration data for each VOC were fit to a linear function. The coefficients of determination for the fit of the data points were 0.98, or better. The calibration data are summarized in Table 6.

### *Aldehydes*

A custom calibration mixture prepared by Absolute Standards, Inc. was used to calibrate the HPLC for the analysis of formaldehyde and acetaldehyde. The mixture contained the 2,4-dinitrophenylhydrazine (DNPH) derivatives of formaldehyde, acetaldehyde, and glutaraldehyde (not used for this study) with acetonitrile as the solvent. The concentration of each target compounds as the aldehyde was 100 µg/mL with an uncertainty of less than 0.5%. The aldehyde mixture was diluted in acetonitrile to produce seven or eight calibration levels ranging from 0.025 to 4.0 ng/µL. The calibration data were fit to a linear function with calculated intercept. The coefficients of determination for the fit of the data points were >0.999.

For the August to October 2006 sampling period, a prior external standard calibration created in March 2006 was verified by the analysis of freshly prepared check standards. The March 2006 calibration prepared using calibration mixture Part No. 93594, Lot No. 21004. The formaldehyde linear term was 721 with an intercept of 3.8; the acetaldehyde linear term was 565 with an intercept of 5.5. A new calibration was created for the January to March 2007 sampling period using calibration mixture Part No. 93594, Lot No. 20107. The formaldehyde linear term was 747 with an intercept of 11.4; the acetaldehyde linear term was 569 with an intercept of 1.9.

## Method Detection Limits

Method detection limits (MDLs) for the target VOCs were determined in conjunction with the analysis of the samples collected from August to October 2006. This was accomplished by making three replicate injections of a low mass VOC calibration standard that approximately was within a factor of five to ten of the anticipated detection limits. Ethylene glycol was analyzed separately using a higher mass standard due to its higher MDL. For each VOC, the MDL was defined as the product of the standard deviation of the measurements and the student's t-value for a 95% confidence level ($t = 2.92$, $p = 0.05$, $df = 2$). The results are shown in Table 7. Typically, the calculated MDLs were 5 ng or less. Compounds with higher MDLs were ethylene glycol, 1-methyl-2-pyrrolidinone, and vinyl acetate. The MDL for ethylene glycol in the second calibration is equal to the intercept of 57 ng plus the calculated value of 16 ng, or 71 ng.

MDLs for formaldehyde and acetaldehyde were determined in May 2006. Seven replicate cartridges were prepared by injecting one microliter of the standard (100 ng of each compound) onto the inlet of each cartridge and purging with helium. The cartridges were extracted and analyzed in the same manner as the field samples. The MDLs defined as the product of the standard deviation of the measurements and the student's t-value for a 95% confidence level ($t = 1.94$, $p = 0.05$, $df = 6$) were about 9 ng for each compound. Using the t-value for a 99% confidence level ($t = 3.14$, $p = 0.01$, $df =6$), the MDLs were 13 to 15 ng.

**External Proficiency Tests**

External proficiency tests were conducted in October 2006 and March 2007 in conjunction with the analyses of samples for the two collection periods (August to October 2006 and January to March 2007). The proficiency test (PT) standards were prepared by Absolute Standards, Inc. under their AbsoluteGrade PT Program. There were three separate standards: one for formaldehyde and acetaldehyde; one for vinyl acetate; and one for the 20-component VOC mixture (19 components with m/p-xylene treated as a single component).

For the VOCs, the vinyl acetate PT mixture and the multi-component VOC PT mixture were diluted 1:100 in methanol. The combined diluted mixture was mixed by sonication. One microliter (1 µL) of the mixture was injected onto each of three multi-sorbent tubes. The ISTD was added and the tubes were purged with helium. The tubes were analyzed as described for samples and other standards. The results for the three tubes were averaged and reported to Absolute Standards, Inc. as concentrations in µg/mL.

For the aldehydes, the PT mixture was diluted 1:100 in acetonitrile and sonicated. Aliquots of the diluted mixture were analyzed in triplicate. The average values in µg/mL were reported to Absolute Standards, Inc.

The results for the first PT conducted in October 2006 are presented in Table 8. For formaldehyde and acetaldehyde, the reported results were "Acceptable," i.e., they were within less than ±20% of the assigned value. For VOCs, the reported results for vinyl acetate and ethylene glycol were outside of the warning limits (±20%), and the reported results for n-hexane and m/p-xylene were outside of the acceptance limits (±40%). A check of the reported data revealed that the "Not Acceptable" result for m/p-xylene was due to a factor of two error in setting up the calibration for this compound. Correction of the error resulted in an Acceptable result. All of the Acceptable results were within ±10% of the assigned values, except alpha-pinene which was 11.7% high.

As described above, separate calibrations were prepared for ethylene glycol using a one-component mixture and for vinyl acetate plus n-hexane using different calibration technique. Recalculation of the PT sample results using these new calibrations produced Acceptable results for all three compounds as shown in Table 8.

The results for the second PT conducted in March 2007 are presented in Table 9. The results for all aldehyde and VOC target compounds were Acceptable. With the exceptions of vinyl acetate, ethylene glycol, and phenol, the results were within ±12% of the assigned values. Vinyl acetate was 14.4% low; ethylene glycol was 15.5% high; and phenol was 13.5% high.

## Analysis of Field Samples

### *Problems Encountered*

A problem was encountered with the analysis of aldehyde samples collected in the Winter-South sampling campaign. This problem was not discovered until after all of the samples for this sampling campaign had been processed. A review of all of the data showed that the chromatographic peak representing the unreacted DNPH was substantially lower in two samples, 084-f2-020107 and 086-f1d-020507. The cartridges contain approximately sufficient DNPH to collect 70 µg of formaldehyde or 2.3 µmol of total carbonyl, which is well in excess of the amount required for most environmental samples. The DNPH peak areas in these two samples were apparent low outliers. These areas fell below the lower 95% confidence interval for the area responses of the DNPH peak in all of the other samples. In addition, the summed areas of the carbonyl hydrazone derivatives in these samples were low relative to the other similar samples suggesting that there was a problem either with the automated injection of the samples into the HPLC instrument or that the extracts of these samples had not been properly mixed during preparation. Results for these two samples were not reported due to an assumed laboratory error.

## References


ASTM. 2003. *Standard Test Method for Determination of Formaldehyde and Other Carbonyl Compounds in Air (Active Sampler Methodology)*. ASTM International, West Conshohocken, Pennsylvania.

U.S. EPA. 1984. *Method TO-1, Revision 1.0: Method for the Determination of Volatile Organic Compounds in Ambient Air Using Tenax Adsorption and Gas Chromatography/Mass Spectrometry (GC/MS)*. Center for Environmental Research Information, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio.

U.S. EPA. 1999. *Compendium Method TO-17; Determination of Volatile Organic Compounds in Ambient Air Using Active Sampling Onto Sorbent Tubes*. Center for Environmental Research Information, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio.

**Table 1**. Thermal desorption conditions.

| Parameter | Value |
|---|---|
| Instrument | Markes Intn. Unity / Ultra TD |
| Purge time | 1 min |
| Tube desorb time | 10 min |
| Tube desorb temperature | 285$^{o}$C |
| Trap temperature | -6$^{o}$C |
| Trap hold time | 3 min |
| Trap desorb temperature | 300$^{o}$C |
| Trap heating rate | Maximum |
| Trap desorb split ratio | 5:1 |
| Flow path temperature | 175$^{o}$C |

**Table 2**. GC conditions.

| Parameter | Value |
|---|---|
| Instrument | Agilent 6890N GC |
| Column type | Agilent DB-1701 |
| Column dimensions | 1 µm, 0.25 mm, 30 m |
| Initial pressure | 13.5 psi |
| Initial pressure time | 10 min |
| Pressure ramp rate | 0.4 psi/min |
| Final pressure | 18 psi |
| Initial temperature | 1$^{o}$C |
| Initial temperature time | 6.5 min |
| Temperature ramp rate 1 | 5$^{o}$C/min |
| Final temperature 1 | 100$^{o}$C |
| Temperature ramp rate 2 | 12 $^{o}$C/min |
| Final temperature 2 | 225$^{o}$C |
| Final temperature 2 time | 2 min |
| Post run temperature | 250$^{o}$C |
| Post run temperature time | 2 min |

**Table 3**. MS conditions.

| Parameter | Value |
|---|---|
| Instrument | Agilent 5973N MSD |
| Solvent delay | 2.25 min |
| Low scan mass, *m/z* | 30 amu |
| High scan mass, *m/z* | 450 amu |
| Threshold | 500 |
| Scan rate | 0.5 Hz |

**Table 4**. HPLC conditions.

| Parameter | Value |
|---|---|
| Instrument | Hewlett-Packard 1050 |
| Solvent A | Acetonitrile (ACN) |
| Solvent B | 65% H20 / 35% ACN |
| Flow rate | 0.3 mL/min |
| Initial solvent time | 2 min |
| Initial solvent | 100% B |
| Solvent ramp | 2–9 min |
| Final solvent | 45% B |
| Solvent hold | 9–6 min |
| Post run time | 5 min |
| Injection volume | 6 µL |
| Detector wavelength | 360 nm |

**Table 5**. VOC calibration mixtures prepared by Absolute Standards, Inc. Vinyl acetate mixture Part No. 82477, Lot No. 070506 was prepared in water. Multi-component VOC mixture Part No. 94336, Lot No. 080206 was prepared in methanol. Both mixtures were prepared using pure (98% purity or higher) compounds. Compound amounts were determined by weighing. Uncertainty was ±0.2% (except caprolactam ±0.5%).

| Compound | CAS No. | Conc (µg/mL) |
|---|---|---|
| Vinyl acetate | 108-05-4 | 20,010 |
| Benzene | 71-43-2 | 2,003 |
| 2-Butoxyethanol | 111-76-2 | 2,001 |
| Caprolactam | 105-60-2 | 2,003 |
| Chloroform | 67-66-3 | 2,003 |
| 1,4-Dichlorobenzene | 106-46-7 | 2,001 |
| Ethylene glycol | 107-21-1 | 2,003 |
| Hexanal | 66-25-1 | 2,001 |
| n-Hexane | 110-54-3 | 2,002 |
| R-(+)-Limonene | 5989-27-5 | 2,001 |
| 1-Methyl-2-pyrrolidinone | 872-50-4 | 2,003 |
| Naphthalene | 91-20-3 | 2,002 |
| Phenol | 108-95-2 | 2,002 |
| (1R)-(+)-alpha-Pinene | 7785-70-8 | 2,001 |
| Styrene | 100-42-5 | 2,004 |
| Tetrachloroethene | 127-18-4 | 2,002 |
| Toluene | 108-88-3 | 2,003 |
| 1,2,4-Trimethylbenzene | 95-63-6 | 2,003 |
| o-Xylene | 95-47-6 | 2,002 |
| m-Xylene | 108-38-3 | 1,001 |
| p-Xylene | 106-42-3 | 1,002 |

**Table 6**. Summary of calibration data showing for each individual VOC the quantitative ion, the number of full multi-point calibrations performed, the compound retention times relative to the retention time of the internal standard (ISTD), and the average linear term (±1 standard deviation) for the calibration.

| Compound | Quant Ion (m/z) | No. Calib | Relative RT Avg ± 1 Stdev | Linear Term Avg ± 1 Stdev |
|---|---|---|---|---|
| 1-Bromo-4-fluorobenzene | 95 | -- | ISTD | -- |
| n-Hexane | 57 | 1 | 0.311 ± 0.002 | 1.01 |
| Vinyl acetate | 43 | 1 | 0.424 ± 0.001 | 1.71 |
| Ethylene glycol | 31 | 2 | 0.867 ± 0.002 | 0.853 ± 0.006 |
| Benzene | 78 | 3 | 0.542 ± 0.002 | 2.62 ± 0.14 |
| 2-Butoxyethanol | 57 | 3 | 1.007 ± 0.002 | 1.70 ± 0.12 |
| Caprolactam | 113 | 3 | 1.359 ± 0.021 | 0.716 ± 0.110 |
| Chloroform | 83 | 3 | 0.528 ± 0.002 | 1.13 ± 0.08 |
| 1,4-Dichlorobenzene | 146 | 3 | 1.094 ± 0.001 | 2.24 ± 0.20 |
| Hexanal | 44 | 3 | 0.835 ± 0.001 | 0.571 ± 0.015 |
| R-(+)-Limonene | 68 | 3 | 1.062 ± 0.001 | 1.32 ± 0.03 |
| 1-Methyl-2-pyrrolidinone | 99 | 3 | 1.199 ± 0.003 | 1.26 ± 0.07 |
| Naphthalene | 128 | 3 | 1.242 ± 0.003 | 6.63 ± 0.25 |
| Phenol | 94 | 3 | 1.184 ± 0.002 | 2.43 ± 0.03 |
| (1R)-(+)-alpha-Pinene | 93 | 3 | 0.926 ± 0.001 | 1.91 ± 0.05 |
| Styrene | 104 | 3 | 0.942 ± 0.001 | 2.52 ± 0.09 |
| Tetrachloroethene | 166 | 3 | 0.754 ± 0.001 | 1.01 ± 0.03 |
| Toluene | 91 | 3 | 0.729 ± 0.001 | 3.03 ± 0.03 |
| 1,2,4-Trimethylbenzene | 105 | 3 | 1.056 ± 0.001 | 3.54 ± 0.12 |
| o-Xylene | 91 | 3 | 0.928 ± 0.001 | 3.03 ± 0.14 |

**Table 7**. Determination of VOC method detection limits (MDLs), Aug.–Oct. 2006 analysis period. Calculated as 95% confidence interval for three replicate analyses of a low mass calibration standard.

| Compound | Avg ± 1 Sdev (ng) | RSD (%) | MDL (ng) |
|---|---|---|---|
| Benzene | 20.7 ± 1.2 | 5.8 | 3.5 |
| 2-Butoxyethanol | 11.7 ± 0.6 | 5.5 | 1.9 |
| Caprolactam | 41.0 ± 1.2 | 2.8 | 3.4 |
| Chloroform | 18.3 ± 1.7 | 9.1 | 4.9 |
| 1,4-Dichlorobenzene | 21.9 ± 1.0 | 4.6 | 2.9 |
| Ethylene glycol | 69.0 ± 5.6 | 8.1 | 16.4 |
| Hexanal | 26.8 ± 0.5 | 1.8 | 1.4 |
| n-Hexane | 3.6 ± 1.5 | 40 | 4.2 |
| R-(+)-Limonene | 21.7 ± 1.5 | 6.7 | 4.2 |
| 1-Methyl-2-pyrrolidinone | 28.0 ± 2.1 | 7.4 | 6.0 |
| Naphthalene | 24.5 ± 0.7 | 2.8 | 2.0 |
| Phenol | 24.5 ± 0.9 | 3.8 | 2.8 |
| (1R)-(+)-alpha-Pinene | 21.0 ± 1.0 | 4.9 | 3.0 |
| Styrene | 22.5 ± 1.1 | 4.8 | 3.1 |
| Tetrachloroethene | 20.3 ± 1.6 | 7.9 | 4.6 |
| Toluene | 21.5 ± 1.7 | 7.9 | 4.9 |
| 1,2,4-Trimethylbenzene | 19.9 ± 1.1 | 5.7 | 3.3 |
| Vinyl acetate | 19.1 ± 1.9 | 10.0 | 5.6 |
| o-Xylene | 21.1 ± 1.1 | 5.2 | 3.2 |
| m/p-Xylene | 21.9 ± 1.3 | 6.0 | 3.8 |

**Table 8**. External PT sample results for October 2006, Absolute Standards, Inc. Formaldehyde-DNPH and Acetaldehyde-DNPH Part No. 38178, Lot No. 092106. Vinyl Acetate Part No. 38198, Lot No. 092106. VOCs Part No. 38197, Lot No. 092106.

| Compound | Reported (µg/mL) | Assigned (µg/mL) | Deviation (%) | Performance Evaluation |
|---|---|---|---|---|
| Formaldehyde | 1.23 | 1.34 | -8.2 | Accept |
| Acetaldehyde | 1.71 | 1.77 | -3.4 | Accept |
| Vinyl acetate | 350 | 251 | +39.4 | Not Accept |
| Vinyl acetate – new calib | (264)* | 251 | (+5.2) | (Accept) |
| Benzene | 343 | 314 | +9.2 | Accept |
| 2-Butoxyethanol | 349 | 335 | +4.2 | Accept |
| Caprolactam | 332 | 307 | +8.1 | Accept |
| Chloroform | 82.4 | 76.7 | +7.4 | Accept |
| 1,4-Dichlorobenzene | 312 | 295 | +5.8 | Accept |
| Ethylene glycol | 617 | 482 | +28.0 | Not Accept |
| Ethylene glycol – new calib | (393) | 482 | (-18.5) | (Accept) |
| Hexanal | 60.5 | 63.2 | -3.6 | Accept |
| n-Hexane | 290 | 194 | +49.5 | Not Accept |
| n-Hexane – new calib | (221) | 194 | (+13.9) | Accept |
| R-(+)-Limonene | 150 | 152 | -1.3 | Accept |
| 1-Methyl-2-pyrrolidinone | 416 | 395 | +5.3 | Accept |
| Naphthalene | 105 | 111 | -5.4 | Accept |
| Phenol | 126 | 133 | -5.3 | Accept |
| (1R)-(+)-alpha-Pinene | 297 | 266 | +11.7 | Accept |
| Styrene | 113 | 111 | +1.8 | Accept |
| Tetrachloroethene | 138 | 136 | +1.5 | Accept |
| Toluene | 154 | 150 | +2.7 | Accept |
| 1,2,4-Trimethylbenzene | 455 | 452 | +0.7 | Accept |
| o-Xylene | 186 | 182 | +2.2 | Accept |
| m/p-Xylene | 634** | 596 | +6.4 | Accept |

*Values in parentheses were calculated using new calibrations for these target compounds
**Originally reported as 1238 µg/mL

**Table 9**. External PT sample results for March 2007 analysis period, Absolute Standards Inc. Formaldehyde-DNPH and Acetaldehyde-DNPH Part No. 38178, Lot No. 020507. Vinyl Acetate Part No. 38198, Lot No. 020507. VOCs Part No. 38197, Lot No. 020507.

| Compound | Reported (µg/mL) | Assigned (µg/mL) | Deviation (%) | Performance Evaluation |
|---|---|---|---|---|
| Formaldehyde | 1.55 | 1.69 | -8.3 | Accept |
| Acetaldehyde | 1.33 | 1.45 | -8.3 | Accept |
| Vinyl acetate | 95.9 | 112 | -14.4 | Accept |
| Benzene | 155 | 156 | -.06 | Accept |
| 2-Butoxyethanol | 77.2 | 69.4 | +11.2 | Accept |
| Caprolactam | 88.2 | 87.8 | +0.5 | Accept |
| Chloroform | 160 | 152 | +5.3 | Accept |
| 1,4-Dichlorobenzene | 210 | 189 | +11.1 | Accept |
| Ethylene glycol | 216 | 187 | +15.5 | Accept |
| Hexanal | 55.1 | 55.0 | +0.2 | Accept |
| n-Hexane | 60.1 | 63.6 | -5.5 | Accept |
| R-(+)-Limonene | 232 | 219 | +5.9 | Accept |
| 1-Methyl-2-pyrrolidinone | 382 | 367 | +4.1 | Accept |
| Naphthalene | 113 | 103 | +9.7 | Accept |
| Phenol | 89.1 | 78.5 | +13.5 | Accept |
| (1R)-(+)-alpha-Pinene | 253 | 241 | +5.0 | Accept |
| Styrene | 476 | 459 | +3.7 | Accept |
| Tetrachloroethene | 281 | 263 | +6.8 | Accept |
| Toluene | 61.1 | 57.2 | +6.8 | Accept |
| 1,2,4-Trimethylbenzene | 453 | 457 | -0.9 | Accept |
| o-Xylene | 54.5 | 53.2 | +2.4 | Accept |
| m/p-Xylene | 312 | 297 | +5.1 | Accept |

# APPENDIX C

## "All Homes" Sample Frame List

Appendix Key

| Label | Description |
|---|---|
| DOA | Ducted Outdoor Air Mechanical Outdoor Air Ventilation System |
| WHF | Whole House Fan Nighttime Cooling System |
| HRV | Heat Recovery Ventilator Mechanical Outdoor Air Ventilation System |
| RAD | Forced Air Unit Return Air Damper Nighttime Cooling System |
| WDF | Window Fan |
| EC | Evaporative Cooler |

| Home ID | UCB ID | Season | Region | City | Zip Code | UCB Statewide | UCB Builder | Supplemental | Mechanical |
|---|---|---|---|---|---|---|---|---|---|
| 001 | 210052 | Summer | North | Brentwood | 94513 | X | | | DOA |
| 002 | | Winter | North | Brentwood | 94513 | | | X | |
| 003 | 310030 | Summer | North | Brentwood | 94513 | X | | | |
| 004 | | Summer | North | Brentwood | 94513 | | | X | DOA |
| 005 | 110033 | Winter | North | Discovery Bay | 94514 | X | | | |
| 006 | | Winter | North | Discovery Bay | 94514 | | | X | |
| 008 | 610013 | Summer | North | Brentwood | 94513 | | X | | DOA |
| 009 | | Summer | North | Brentwood | 94513 | | | X | DOA |
| 010 | | Summer | North | Brentwood | 94513 | | | X | DOA |
| 011 | | Winter | North | Brentwood | 94513 | | | X | DOA |
| 012 | | Summer | North | Brentwood | 94513 | | | X | DOA |
| 013 | | Summer | North | Elk Grove | 95624 | | | X | |
| 014 | | Summer | North | Elk Grove | 95624 | | | X | |
| 015 | 210456 | Summer | North | Elk Grove | 95624 | X | | | WHF |
| 016 | 210518 | Summer | North | Elk Grove | 95758 | X | | | HRV |
| 017 | 110261 | Winter | North | Elk Grove | 95758 | X | | | HRV |
| 018 | 210512 | Summer | North | Elk Grove | 95758 | X | | | HRV, RAD |
| 019 | 110228 | Summer | North | Elk Grove | 95624 | X | | | RAD |
| 020 | 110225 | Summer | North | Elk Grove | 95624 | X | | | |
| 021 | 210482 | Summer | North | Elk Grove | 95624 | X | | | DOA |
| 022 | | Summer | North | Sacramento | 95835 | | | X | HRV |
| 023 | 110313 | Summer | North | Sacramento | 95835 | X | | | |
| 024 | | Summer | North | Sacramento | 95835 | | | X | WHF, HRV |
| 025 | 210516 | Summer | North | Elk Grove | 95758 | X | | | HRV, RAD |
| 026 | | Summer | North | Elk Grove | 95758 | | | X | HRV |
| 027 | | Summer | North | Elk Grove | 95758 | | | X | |
| 029 | | Summer | North | Manteca | 95337 | | | X | |

| Home ID | UCB ID | Season | Region | City | Zip Code | UCB Statewide | UCB Builder | Supplemental | Mechanical |
|---|---|---|---|---|---|---|---|---|---|
| 030 | | Summer | North | Manteca | 95337 | | | X | |
| 031 | 231940 | Summer | North | Manteca | 95337 | X | | | |
| 032 | 130965 | Summer | North | Manteca | 95337 | X | | | |
| 033 | 330997 | Summer | North | Rancho Murrieta | 95683 | X | | | |
| 034 | 231990 | Summer | North | Rancho Murrieta | 95683 | X | | | WHF |
| 037 | 631001 | Summer | South | Valencia | 91381 | | X | | |
| 038 | | Winter | South | Valencia | 91381 | | | X | |
| 039 | 631002 | Winter | South | Valencia | 91381 | | X | | |
| 040 | | Summer | South | Castaic | 91384 | | | X | |
| 041 | 330036 | Winter | South | Castaic | 91384 | X | | | |
| 042 | 330048 | Summer | South | Castaic | 91384 | X | | | |
| 043 | | Summer | South | Santa Clarita | 91390 | | | X | 2 x DOA |
| 044 | 220248 | Summer | South | Santa Clarita | 91390 | X | | | WD, WHF |
| 045 | | Summer | South | Santa Clarita | 91390 | | | X | |
| 046 | | Summer | South | Canyon Country | 91387 | | | X | |
| 047 | 620046 | Summer | South | Canyon Country | 91387 | | X | | |
| 048 | 620037 | Summer | South | Canyon Country | 91387 | | X | | |
| 049 | 130106 | Winter | South | Chula Vista | 91914 | X | | | |
| 050 | 230210 | Summer | South | Chula Vista | 91914 | X | | | |
| 053 | 220452 | Summer | South | San Diego | 92129 | X | | | |
| 054 | 220454 | Summer | South | San Diego | 92129 | X | | | |
| 055 | 220507 | Summer | South | San Diego | 92129 | X | | | |
| 056 | 220499 | Summer | South | San Diego | 92129 | X | | | |
| 058 | 230500 | Winter | South | San Marcos | 92078 | X | | | DOA, EC |
| 059 | 130200 | Summer | South | San Marcos | 92078 | X | | | |
| 061 | | Summer | South | Castaic | 91384 | | | X | |
| 062 | 230104 | Summer | South | Castaic | 91384 | X | | | |
| 064 | | Summer | South | Santa Clarita | 91390 | | | X | |
| 065 | | Summer | South | Santa Clarita | 91390 | | | X | |
| 066 | | Summer | South | Santa Clarita | 91390 | | | X | |

| Home ID | UCB ID | Season | Region | City | Zip Code | UCB Statewide | UCB Builder | Supplemental | Mechanical |
|---|---|---|---|---|---|---|---|---|---|
| 067 | | Summer | South | Palmdale | 93551 | | | X | |
| 068 | | Summer | South | Palmdale | 93551 | | | X | |
| 069 | | Summer | South | Palmdale | 93551 | | | X | |
| 070 | 330737 | Summer | South | Palmdale | 93551 | X | | | |
| 071 | | Summer | South | Palmdale | 93551 | | | X | |
| 072 | | Summer | South | Palmdale | 93551 | | | X | |
| 073 | | Winter | South | Santa Clarita | 91390 | | | X | |
| 074 | 120138 | Winter | South | Santa Clarita | 91390 | X | | | |
| 075 | | Winter | South | Valencia | 91381 | | | X | |
| 076 | 130051 | Winter | South | Castaic | 91384 | X | | | |
| 077 | | Winter | South | Santa Clarita | 91390 | | | X | |
| 078 | | Winter | South | San Marcos | 92069 | | | X | |
| 079 | | Winter | South | San Marcos | 92069 | | | X | |
| 080 | 230214 | Winter | South | Chula Vista | 91914 | X | | | |
| 081 | | Winter | South | San Marcos | 92078 | | | X | |
| 083 | 220423 | Winter | South | San Diego | 92129 | X | | | DOA |
| 084 | | Winter | South | San Diego | 92129 | | | X | |
| 085 | | Winter | South | San Diego | 92129 | | | X | |
| 086 | | Winter | South | Fontana | 92336 | | | X | |
| 087 | | Winter | South | Fontana | 92336 | | | X | |
| 088 | | Winter | South | Fontana | 92336 | | | X | WHF |
| 089 | | Winter | South | Fontana | 92336 | | | X | |
| 090 | | Winter | South | Fontana | 92336 | | | X | |
| 091 | | Winter | South | Fontana | 92336 | | | X | |
| 092 | | Winter | South | Fontana | 92336 | | | X | |
| 093 | | Winter | South | Fontana | 92336 | | | X | |
| 094 | | Winter | South | Riverside | 92508 | | | X | |
| 095 | | Winter | South | Riverside | 92508 | | | X | |
| 096 | | Winter | South | Riverside | 92508 | | | X | |
| 097 | | Winter | North | Elk Grove | 95624 | | | X | HRV |
| 098 | | Winter | North | Elk Grove | 95624 | | | X | |
| 099 | | Winter | North | Sacramento | 95835 | | | X | DOA |

| Home ID | UCB ID | Season | Region | City | Zip Code | UCB Statewide | UCB Builder | Supplemental | Mechanical |
|---|---|---|---|---|---|---|---|---|---|
| 101 | | Winter | North | Sacramento | 95835 | | | X | |
| 102 | | Winter | North | Sacramento | 95835 | | | X | DOA |
| 104 | | Winter | North | Sacramento | 95835 | | | X | HRV |
| 105 | 210066 | Winter | North | Discovery Bay | 94514 | X | | | |
| 106 | | Winter | North | Stockton | 95219 | | | X | |
| 107 | | Winter | North | Stockton | 95219 | | | X | |
| 108 | | Winter | North | Stockton | 95219 | | | X | |
| 109 | 510018 | Winter | North | Brentwood | 94513 | | X | | DOA |
| 110 | 510034 | Winter | North | Brentwood | 94513 | | X | | DOA |
| 112 | | Winter | North | El Dorado Hills | 95762 | | | X | RAD |
| 113 | | Winter | North | El Dorado Hills | 95762 | | | X | |
| 114 | | Winter | North | El Dorado Hills | 95762 | | | X | |
| 115 | | Winter | North | El Dorado Hills | 95762 | | | X | |
| 116 | | Winter | North | El Dorado Hills | 95762 | | | X | RAD |
| 117 | | Winter | North | Lincoln | 95648 | | | X | RAD |
| 118 | | Winter | North | Lincoln | 95648 | | | X | DOA |
| 119 | 530015 | Winter | North | Lincoln Hills | 95648 | | X | | DOA |
| 120 | | Winter | North | Folsom | 95630 | | | X | |
| 121 | | Winter | North | Folsom | 95630 | | | X | |

# APPENDIX D

## Home-Season Test List

Appendix Key

| Label | Description |
|---|---|
| DOA | Ducted Outdoor Air Mechanical Outdoor Air Ventilation System |
| WHF | Whole House Fan Nighttime Cooling System |
| HRV | Heat Recovery Ventilator Mechanical Outdoor Air Ventilation System |
| RAD | Forced Air Unit Return Air Damper Nighttime Cooling System |
| WDF | Window Fan |
| EC | Evaporative Cooler |

| Home ID | Season | Region | City | Mechanical |
|---|---|---|---|---|
| 001 | Summer | North | Brentwood | DOA |
| 002 | Summer | North | Brentwood | |
| 002 | Winter | North | Brentwood | |
| 003 | Summer | North | Brentwood | |
| 004 | Summer | North | Brentwood | DOA |
| 004 | Winter | North | Brentwood | DOA |
| 005 | Summer | North | Discovery Bay | |
| 005 | Winter | North | Discovery Bay | |
| 005 | Fall | North | Discovery Bay | |
| 006 | Summer | North | Discovery Bay | |
| 006 | Winter | North | Discovery Bay | |
| 006 | Fall | North | Discovery Bay | |
| 008 | Summer | North | Brentwood | DOA |
| 008 | Winter | North | Brentwood | DOA |
| 009 | Summer | North | Brentwood | DOA |
| 010 | Summer | North | Brentwood | DOA |
| 011 | Summer | North | Brentwood | DOA |
| 011 | Winter | North | Brentwood | DOA |
| 012 | Summer | North | Brentwood | DOA |
| 013 | Summer | North | Elk Grove | |
| 013 | Fall | North | Elk Grove | |
| 014 | Summer | North | Elk Grove | |
| 015 | Summer | North | Elk Grove | WHF |
| 016 | Summer | North | Elk Grove | HRV |
| 017 | Summer | North | Elk Grove | HRV |
| 017 | Winter | North | Elk Grove | HRV |
| 018 | Summer | North | Elk Grove | HRV, RAD |
| 018 | Winter | North | Elk Grove | HRV, RAD |
| 019 | Summer | North | Elk Grove | RAD |
| 019 | Winter | North | Elk Grove | RAD |
| 019 | Fall | North | Elk Grove | RAD |
| 020 | Summer | North | Elk Grove | |
| 021 | Summer | North | Elk Grove | DOA |
| 022 | Summer | North | Sacramento | HRV |
| 023 | Summer | North | Sacramento | |
| 024 | Summer | North | Sacramento | WHF, HRV |
| 025 | Summer | North | Elk Grove | HRV, RAD |
| 025 | Winter | North | Elk Grove | HRV, RAD |
| 026 | Summer | North | Elk Grove | HRV |
| 027 | Summer | North | Elk Grove | |
| 029 | Summer | North | Manteca | |
| 030 | Summer | North | Manteca | |
| 031 | Summer | North | Manteca | |
| 032 | Summer | North | Manteca | |
| 033 | Summer | North | Rancho Murrieta | |
| 034 | Summer | North | Rancho Murrieta | WHF |
| 037 | Summer | South | Valencia | |

| Home ID | Season | Region | City | Mechanical |
|---|---|---|---|---|
| 038 | Summer | South | Valencia | |
| 038 | Winter | South | Valencia | |
| 039 | Summer | South | Valencia | |
| 039 | Winter | South | Valencia | |
| 040 | Summer | South | Castaic | |
| 041 | Summer | South | Castaic | |
| 041 | Winter | South | Castaic | |
| 042 | Summer | South | Castaic | |
| 043 | Summer | South | Santa Clarita | 2 x DOA |
| 044 | Summer | South | Santa Clarita | WD, WHF |
| 044 | Winter | South | Santa Clarita | WD, WHF |
| 045 | Summer | South | Santa Clarita | |
| 045 | Winter | South | Santa Clarita | |
| 046 | Summer | South | Canyon Country | |
| 047 | Summer | South | Canyon Country | |
| 048 | Summer | South | Canyon Country | |
| 049 | Summer | South | Chula Vista | |
| 049 | Winter | South | Chula Vista | |
| 050 | Summer | South | Chula Vista | |
| 050 | Winter | South | Chula Vista | |
| 053 | Summer | South | San Diego | |
| 054 | Summer | South | San Diego | |
| 055 | Summer | South | San Diego | |
| 056 | Summer | South | San Diego | |
| 058 | Summer | South | San Marcos | DOA, EC |
| 058 | Winter | South | San Marcos | DOA, EC |
| 059 | Summer | South | San Marcos | |
| 059 | Winter | South | San Marcos | |
| 061 | Summer | South | Castaic | |
| 062 | Summer | South | Castaic | |
| 062 | Winter | South | Castaic | |
| 064 | Summer | South | Santa Clarita | |
| 065 | Summer | South | Santa Clarita | |
| 066 | Summer | South | Santa Clarita | |
| 067 | Summer | South | Palmdale | |
| 068 | Summer | South | Palmdale | |
| 069 | Summer | South | Palmdale | |
| 070 | Summer | South | Palmdale | |
| 071 | Summer | South | Palmdale | |
| 072 | Summer | South | Palmdale | |
| 073 | Winter | South | Santa Clarita | |
| 074 | Winter | South | Santa Clarita | |
| 075 | Winter | South | Valencia | |
| 076 | Winter | South | Castaic | |
| 077 | Winter | South | Santa Clarita | |
| 078 | Winter | South | San Marcos | |
| 079 | Winter | South | San Marcos | |
| 080 | Winter | South | Chula Vista | |
| 081 | Winter | South | San Marcos | |
| 083 | Winter | South | San Diego | DOA |

| Home ID | Season | Region | City | Mechanical |
|---|---|---|---|---|
| 084 | Winter | South | San Diego | |
| 085 | Winter | South | San Diego | |
| 086 | Winter | South | Fontana | |
| 087 | Winter | South | Fontana | |
| 088 | Winter | South | Fontana | WHF |
| 089 | Winter | South | Fontana | |
| 090 | Winter | South | Fontana | |
| 091 | Winter | South | Fontana | |
| 092 | Winter | South | Fontana | |
| 093 | Winter | South | Fontana | |
| 094 | Winter | South | Riverside | |
| 095 | Winter | South | Riverside | |
| 096 | Winter | South | Riverside | |
| 097 | Winter | North | Elk Grove | HRV |
| 098 | Winter | North | Elk Grove | |
| 099 | Winter | North | Sacramento | DOA |
| 101 | Winter | North | Sacramento | |
| 102 | Winter | North | Sacramento | DOA |
| 104 | Winter | North | Sacramento | HRV |
| 105 | Winter | North | Discovery Bay | |
| 106 | Winter | North | Stockton | |
| 107 | Winter | North | Stockton | |
| 108 | Winter | North | Stockton | |
| 109 | Winter | North | Brentwood | DOA |
| 110 | Winter | North | Brentwood | DOA |
| 112 | Winter | North | El Dorado Hills | RAD |
| 113 | Winter | North | El Dorado Hills | |
| 114 | Winter | North | El Dorado Hills | |
| 115 | Winter | North | El Dorado Hills | |
| 116 | Winter | North | El Dorado Hills | RAD |
| 117 | Winter | North | Lincoln | RAD |
| 118 | Winter | North | Lincoln | DOA |
| 119 | Winter | North | Lincoln Hills | DOA |
| 120 | Winter | North | Folsom | |
| 121 | Winter | North | Folsom | |

# APPENDIX E

## Air Contaminant and Outdoor Air Exchange Rate PFT Measurements

Appendix Key

| Compound | Abbreviation | Sample ID | Description |
|---|---|---|---|
| Acetaldehyde | Acet | hhh-sample type-location-date | Sample ID |
| Benzene | Benz | hhh = | Home ID |
| 2-Butoxethanol | 2Bto | Sample type | |
| Caprolactam | Capr | V = | Volatile Organic Compounds |
| 1,4-Dichlorobenzene | Dchl | F = | Formaldehyde/Acetaldehyde |
| Ethylene glycol | Ethy | N = | Nitrogen Dioxide |
| Formaldehyde | Form | P = | Particulate Matter $PM_{2.5}$ |
| Hexanal | Hxan | B = | Blank Sample |
| n-Hexane | NHex | C/CC = | CO, $CO_2$, T, RH |
| d-Limonene | dLim | T= | PFT |
| 1-Methyl-2-pyrrolidinone | MePy | Sample Location | |
| Naphthalene | Naph | 1 = | Indoor Sample |
| Phenol | Phen | 2 = | Outdoor Sample |
| Alpha-Pinene | AlP | 1D = | Indoor duplicate |
| Styrene | Styr | 2D = | Outdoor duplicate |
| Tetrachloroethene | Tchlr | FAA/AA = | Attic Air |
| Toluene | Tolu | FSA/SA/SA1/SA2 = | Supply Air |
| Trichloroethene (chloroform) | Clr | FRA/RA = | Return Air |
| 1,2,4- Trimethylbenzene | 124T | Date | mmddyy |
| Vinyl acetate | Viny | **BOLD** concentration or mass | Concentration or mass is ≤ MDL |
| m,p-Xylene | mpXy | | |
| o-Xylene | oXyl | ND | No Data |

Volatile organic compound, sample IDs and concentrations.

| Home ID | Sample ID | Benz (μg/m$^3$) | 2Bto (μg/m$^3$) | Capr (μg/m$^3$) | **Dchl** (μg/m$^3$) | Ethy (μg/m$^3$) | Hxan (μg/m$^3$) | nHex (μg/m$^3$) | dLim (μg/m$^3$) | Mepy (μg/m$^3$) |
|---|---|---|---|---|---|---|---|---|---|---|
| 001 | 001-v1a-080706 | **0.23** | 15.91 | **0.21** | 0.48 | 41.77 | 5.74 | **0.27** | 7.85 | **0.38** |
| 002 | 002-v1a-080706 | **0.25** | **0.13** | **0.24** | **0.21** | 4.10 | 0.74 | **0.30** | **0.30** | **0.43** |
| 002 | 002-v2a-080706 | **0.24** | **0.13** | **0.23** | **0.20** | **1.12** | **0.10** | **0.29** | **0.29** | **0.41** |
| 002 | 002-v1a-030107 | 0.72 | 1.16 | **0.26** | **0.23** | **1.27** | 6.84 | 0.92 | 30.67 | **0.47** |
| 003 | 003-v1b-080706 | **0.18** | 4.44 | **0.17** | **0.15** | 24.80 | 6.56 | **0.22** | 1.36 | **0.31** |
| 004 | 004-v1b-080806 | **0.25** | 11.28 | **0.24** | **0.21** | 12.82 | 4.76 | **0.30** | 6.55 | **0.43** |
| 004 | 004-v1a-030107 | 3.51 | 6.02 | **0.25** | **0.22** | **1.21** | 20.27 | 2.00 | 128.45 | **0.44** |
| 005 | 005-v1b-080806 | 3.13 | 5.67 | **0.23** | 451.05 | 20.26 | 36.96 | 4.48 | 9.92 | **0.42** |
| 005 | 005-v2a-080806 | **0.24** | **0.13** | **0.23** | 0.77 | **1.11** | **0.10** | **0.29** | **0.29** | **0.41** |
| 005 | 005-v1b-102306 | 7.44 | 10.87 | **0.24** | 12.76 | 7.16 | 26.75 | 14.56 | 11.96 | **0.44** |
| 005 | 005-v1a-022707 | 4.90 | 1.54 | **0.22** | 1.78 | **1.09** | 15.37 | 10.66 | 20.59 | **0.40** |
| 006 | 006-v1b-080806 | 1.02 | 3.67 | **0.22** | **0.20** | 6.95 | 27.56 | 1.75 | 9.94 | **0.40** |
| 006 | 006-v1a-102306 | 0.30 | 1.22 | **0.22** | **0.20** | **1.09** | 2.76 | 1.24 | 1.55 | **0.40** |
| 006 | 006-v2b-102306 | **0.24** | **0.13** | **0.23** | **0.20** | **1.10** | **0.09** | 0.52 | **0.28** | **0.40** |
| 006 | 006-v2bd-102306 | **0.24** | **0.13** | **0.23** | **0.20** | **1.12** | **0.10** | 0.53 | **0.29** | **0.41** |
| 006 | 006-v1a-022707 | 1.28 | 7.23 | **0.25** | **0.22** | **1.21** | 14.89 | 1.26 | 18.56 | **0.45** |
| 006 | 006-v2a-022707 | 0.61 | **0.13** | **0.24** | **0.21** | **1.17** | 0.68 | **0.30** | 0.86 | **0.43** |
| 008 | 008-v1a-080906 | 1.06 | 5.58 | **0.24** | 35.63 | 46.63 | 12.81 | 0.60 | 8.94 | **0.42** |
| 008 | 008-v2b-080906 | **0.25** | **0.13** | **0.24** | **0.21** | **1.16** | **0.10** | **0.30** | **0.30** | **0.43** |
| 008 | 008-v1b-030107 | 1.67 | 1.29 | **0.26** | 36.86 | **1.25** | 68.09 | 0.56 | 9.71 | **0.46** |
| 008 | 008-v2a-030107 | 0.66 | **0.14** | **0.24** | **0.21** | **1.19** | **0.10** | **0.31** | **0.31** | **0.44** |
| 009 | 009-v1b-080906 | **0.24** | **0.13** | **0.23** | **0.20** | 51.67 | 17.38 | **0.29** | 31.33 | **0.41** |
| 009 | 009-v1db-080906 | **0.23** | **0.12** | **0.22** | **0.19** | 47.09 | 16.23 | 0.38 | 29.66 | **0.40** |
| 010 | 010-v1a-081006 | 1.27 | 34.31 | **0.24** | **0.21** | 119.48 | 35.05 | 1.45 | 41.90 | **0.44** |
| 011 | 011-v1a-081006 | **0.27** | 183.73 | **0.25** | **0.22** | 101.89 | 38.59 | 1.02 | 17.19 | **0.45** |
| 011 | 011-v2b-081006 | **0.25** | **0.13** | **0.23** | **0.20** | **1.14** | 0.23 | **0.29** | 0.37 | **0.42** |
| 011 | 011-v1a-030207 | 0.71 | 34.17 | **0.23** | **0.20** | 16.80 | 18.24 | 0.67 | 8.16 | **0.41** |
| 012 | 012-v1a-081006 | 0.15 | 3.22 | **0.23** | **0.20** | 15.72 | 3.53 | **0.28** | 0.89 | 0.53 |
| 013 | 013-v1a-081406 | 2.16 | 5.16 | **0.22** | 0.35 | 29.71 | 21.85 | 4.31 | 19.25 | 0.64 |
| 013 | 013-v1a-102406 | 2.11 | 1.55 | **0.22** | 0.36 | 7.79 | 0.95 | 4.17 | 2.64 | **0.39** |
| 013 | 013-v2b-102406 | 0.22 | **0.13** | **0.23** | 0.18 | **1.14** | **0.10** | 0.71 | **0.29** | **0.42** |

Volatile organic compound, sample IDs and concentrations.

| Home ID | Sample ID | Naph ($\mu g/m^3$) | Phen ($\mu g/m^3$) | alP ($\mu g/m^3$) | Styr ($\mu g/m^3$) | TChlr ($\mu g/m^3$) | Tolu ($\mu g/m^3$) | Clr ($\mu g/m^3$) | 124T ($\mu g/m^3$) | Viny ($\mu g/m^3$) | mpXy ($\mu g/m^3$) | oXyl ($\mu g/m^3$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 001 | 001.v1a.080706 | 0.13 | 2.38 | 11.19 | 0.49 | 0.29 | 3.01 | **0.31** | **0.21** | **0.35** | 2.00 | 0.16 |
| 002 | 002.v1a.080706 | **0.14** | 0.42 | **0.21** | **0.22** | **0.33** | 0.78 | **0.34** | **0.23** | **0.39** | 0.13 | **0.23** |
| 002 | 002.v2a.080706 | **0.14** | 0.57 | **0.21** | **0.21** | **0.32** | 0.19 | **0.33** | **0.22** | **0.38** | **0.26** | **0.22** |
| 002 | 002.v1a.030107 | 0.08 | 0.75 | 5.05 | 1.08 | **0.36** | 19.46 | 0.42 | 0.83 | **0.43** | 10.93 | 3.28 |
| 003 | 003.v1b.080706 | 0.06 | 4.12 | 5.47 | **0.16** | **0.24** | 3.86 | **0.25** | **0.17** | **0.28** | 0.91 | **0.16** |
| 004 | 004.v1b.080806 | 0.54 | 2.55 | 15.29 | **0.22** | **0.33** | 4.43 | **0.34** | 0.33 | **0.39** | 1.75 | **0.23** |
| 004 | 004.v1a.030107 | 2.48 | 3.04 | 39.09 | 2.82 | **0.34** | 27.20 | 0.34 | 2.96 | **0.41** | 7.68 | 2.89 |
| 005 | 005.v1b.080806 | 0.53 | 6.40 | 42.53 | 3.69 | **0.32** | 30.84 | **0.34** | 5.26 | **0.39** | 16.96 | 6.35 |
| 005 | 005.v2a.080806 | **0.14** | 0.80 | **0.20** | **0.21** | **0.31** | 1.34 | **0.33** | **0.22** | **0.38** | 0.76 | **0.22** |
| 005 | 005.v1b.102306 | 0.77 | 4.43 | 37.56 | 3.39 | **0.34** | 64.44 | **0.35** | 10.00 | **0.40** | 38.20 | 11.95 |
| 005 | 005.v1a.022707 | 0.42 | 2.85 | 13.49 | 1.27 | **0.31** | 24.16 | **0.32** | 3.65 | **0.37** | 13.92 | 4.52 |
| 006 | 006.v1b.080806 | 0.13 | 3.73 | 32.21 | 1.88 | **0.31** | 12.67 | **0.32** | 1.15 | **0.37** | 5.14 | 1.35 |
| 006 | 006.v1a.102306 | 0.27 | 1.49 | 10.26 | 1.58 | **0.31** | 10.66 | **0.32** | 1.60 | **0.37** | 5.16 | 1.63 |
| 006 | 006.v2a.102306 | 0.20 | 0.46 | **0.20** | 0.47 | **0.31** | 3.18 | **0.33** | 0.84 | **0.37** | 2.26 | 0.72 |
| 006 | 006.v2bd.102306 | 0.21 | 0.50 | **0.21** | 0.41 | **0.32** | 3.07 | **0.33** | 0.79 | **0.38** | 2.03 | 0.65 |
| 006 | 006.v1a.022707 | 0.13 | 1.91 | 11.14 | 1.08 | **0.34** | 10.79 | **0.36** | 1.57 | **0.41** | 4.57 | 1.13 |
| 006 | 006.v2a.022707 | **0.14** | 0.87 | **0.22** | 0.28 | **0.33** | 1.82 | **0.35** | 0.41 | **0.40** | 1.06 | 0.28 |
| 008 | 008.v1a.080907 | 0.11 | 2.68 | 30.00 | 1.42 | **0.33** | 13.69 | 1.66 | 0.92 | **0.39** | 4.44 | 0.92 |
| 008 | 008.v2b.080907 | **0.14** | 0.68 | **0.21** | **0.22** | **0.33** | 1.36 | **0.34** | **0.23** | **0.39** | 0.49 | **0.23** |
| 008 | 008.v1b.030107 | 0.08 | 1.65 | 14.76 | 2.39 | 0.59 | 20.24 | 0.58 | 0.78 | **0.42** | 3.31 | 0.79 |
| 008 | 008.v2a.030107 | 0.14 | **0.56** | **0.22** | **0.23** | **0.34** | 0.60 | **0.35** | 0.14 | **0.40** | 0.32 | **0.23** |
| 009 | 009.v1b.080906 | 0.18 | 3.16 | 30.87 | 0.77 | **0.32** | 3.97 | **0.33** | 0.35 | **0.38** | 1.35 | 0.31 |
| 009 | 009.v1bd.080906 | 0.17 | 2.92 | 28.49 | 0.75 | **0.31** | 3.77 | **0.32** | 0.32 | **0.37** | 1.27 | **0.21** |
| 010 | 010.v1a.081006 | 0.49 | 4.50 | 65.10 | 4.65 | **0.34** | 24.03 | **0.35** | 2.06 | **0.40** | 4.52 | 1.68 |
| 011 | 011.v1a.081006 | 0.74 | 9.62 | 100.59 | 4.97 | **0.35** | 15.02 | **0.36** | 2.06 | **0.42** | 3.10 | 0.27 |
| 011 | 011.v2b.081006 | **0.14** | 0.91 | 0.13 | **0.22** | **0.32** | 1.53 | **0.34** | **0.23** | **0.39** | 0.96 | **0.22** |
| 011 | 011.v1a.030207 | 0.24 | 3.86 | 27.90 | 1.60 | **0.31** | 47.53 | **0.33** | 1.22 | 0.29 | 14.61 | 1.81 |
| 012 | 012.v1a.081006 | **0.13** | 3.56 | 9.20 | 0.36 | **0.31** | 4.93 | **0.33** | **0.22** | **0.37** | 1.86 | 0.21 |
| 013 | 013.v1a.081406 | 0.40 | 3.48 | 58.34 | 2.81 | **0.31** | 114.40 | 1.31 | 2.50 | **0.37** | 20.68 | 5.79 |
| 013 | 013.v1a.102406 | 0.37 | 1.09 | 16.63 | 1.00 | **0.30** | 66.11 | 0.40 | 3.29 | **0.36** | 16.31 | 5.11 |
| 013 | 013.v2b.102406 | 0.21 | 0.39 | **0.21** | **0.22** | **0.32** | 5.03 | **0.34** | 1.14 | **0.39** | 3.18 | 1.04 |

Volatile organic compound, sample IDs and concentrations.

| Home ID | Sample ID | Benz (μg/m$^3$) | 2Bto (μg/m$^3$) | Capr (μg/m$^3$) | **Dchl** (μg/m$^3$) | Ethy (μg/m$^3$) | Hxan (μg/m$^3$) | nHex (μg/m$^3$) | dLim (μg/m$^3$) | Mepy (μg/m$^3$) |
|---|---|---|---|---|---|---|---|---|---|---|
| 014 | 014-v1b-081406 | **0.25** | **0.13** | **0.23** | **0.20** | **1.14** | 1.16 | **0.29** | **0.29** | **0.42** |
| 014 | 014-v2b-081406 | **0.25** | **0.13** | **0.24** | **0.21** | **1.15** | **0.10** | **0.30** | **0.30** | **0.42** |
| 015 | 015-v1a-081406 | **0.25** | **0.13** | **0.23** | 0.86 | 3.31 | 0.93 | **0.29** | **0.29** | **0.42** |
| 016 | 016-v1b-081506 | **0.23** | **0.12** | **0.22** | 0.68 | 0.85 | 0.64 | **0.28** | **0.28** | **0.40** |
| 017 | 017-v1a-081506 | **0.26** | 1.00 | **0.24** | **0.21** | **1.19** | 0.45 | **0.31** | 1.87 | **0.44** |
| 017 | 017-v2b-081506 | **0.25** | **0.13** | **0.23** | **0.20** | **1.14** | 0.05 | **0.29** | 3.10 | **0.42** |
| 017 | 017-v1a-022107 | 0.44 | 2.63 | 0.27 | **0.23** | 5.17 | 3.91 | **0.34** | 7.95 | **0.48** |
| 017 | 017-v2a-022107 | 0.32 | 0.14 | **0.26** | **0.23** | **1.26** | 0.50 | **0.33** | **0.33** | **0.46** |
| 018 | 018-v1a-081506 | **0.22** | 2.20 | **0.21** | **0.19** | 3.04 | 1.31 | **0.27** | 0.86 | **0.38** |
| 018 | 018-v1bd-081506 | **0.23** | 1.84 | **0.22** | **0.19** | 3.43 | 1.66 | **0.28** | 0.58 | 0.79 |
| 018 | 018-v1b-022107 | 0.42 | 4.88 | **0.25** | **0.22** | 8.69 | 3.04 | **0.32** | 11.91 | **0.45** |
| 019 | 019-v1a-081606 | **0.28** | **0.15** | **0.27** | **0.24** | **1.31** | **0.11** | **0.34** | **0.34** | 0.72 |
| 019 | 019-v1b-102406 | 0.94 | 3.64 | **0.22** | **0.19** | **1.07** | 1.15 | 1.97 | 3.86 | **0.39** |
| 019 | 019-v1b-022007 | 1.74 | 9.89 | **0.24** | 0.15 | **1.15** | 14.32 | 1.86 | 12.71 | **0.42** |
| 019 | 019-v1bd-022007 | 1.85 | 1.55 | **0.25** | 0.15 | **1.22** | 17.21 | 1.88 | 12.78 | **0.45** |
| 020 | 020-v1b-081606 | 5.45 | 1.21 | **0.22** | **0.19** | 35.69 | 15.38 | 12.67 | 7.64 | 8.25 |
| 020 | 020-v2b-081606 | **0.26** | **0.14** | **0.25** | **0.22** | **1.21** | **0.10** | **0.31** | **0.31** | **0.45** |
| 021 | 021-v1a-081606 | 0.82 | 6.03 | **0.24** | 3.08 | 0.89 | 24.09 | 1.08 | 18.73 | **0.42** |
| 022 | 022-v1b-081706 | **0.28** | 0.90 | **0.27** | 161.32 | 11.36 | 7.93 | 0.45 | 26.63 | **0.47** |
| 023 | 023-v1b-081706 | **0.27** | **0.14** | **0.26** | **0.23** | 69.42 | 17.78 | 0.47 | 25.96 | **0.46** |
| 023 | 023-v2a-081706 | **0.26** | **0.14** | **0.24** | **0.21** | **1.19** | **0.10** | **0.31** | **0.31** | **0.44** |
| 024 | 024-v1b-081706 | **0.27** | **0.14** | **0.26** | **0.22** | 99.53 | 5.81 | **0.32** | 3.50 | **0.46** |
| 025 | 025-v1a-082106 | **0.25** | **0.13** | **0.24** | **0.21** | 7.01 | 1.66 | **0.30** | 1.06 | **0.43** |
| 025 | 025-v1b-022107 | 0.83 | 1.64 | **0.23** | 0.14 | **1.10** | 8.16 | **0.28** | 32.67 | **0.40** |
| 026 | 026-v1a-082106 | **0.25** | **0.14** | **0.24** | **0.21** | 33.83 | 5.03 | **0.31** | 1.57 | **0.43** |
| 026 | 026-v2a-082106 | **0.25** | **0.13** | **0.24** | **0.21** | **1.15** | 0.27 | **0.30** | 1.45 | **0.42** |
| 027 | 027-v1a-082106 | 1.24 | 2.87 | **0.23** | **0.20** | 34.04 | 5.02 | 1.86 | 1.65 | **0.41** |
| 029 | 029-v1a-082206 | 0.40 | 5.44 | **0.23** | **0.20** | 6.29 | 18.21 | 0.76 | 10.91 | **0.41** |
| 029 | 029-v2a-082206 | **0.28** | **0.15** | **0.27** | **0.23** | **1.29** | **0.11** | **0.33** | **0.33** | **0.47** |
| 030 | 030-v1a-082206 | 4.28 | 3.87 | **0.24** | **0.21** | 3.23 | 11.02 | 7.64 | 31.55 | 0.66 |
| 030 | 030-v1ad-082206 | 3.96 | 4.76 | **0.23** | **0.20** | 5.37 | 10.73 | 7.11 | 29.85 | 0.59 |
| 031 | 031-v1b-082306 | 2.0 | 3.2 | **0.2** | **0.2** | **1.2** | 11.3 | 4.5 | 4.0 | 0.4 |
| 032 | 032-v1b-082306 | 1.0 | **0.1** | **0.2** | **0.2** | 34.8 | 2.2 | 2.3 | 7.1 | **0.4** |
| 032 | 032-v2b-082306 | **0.3** | **0.1** | **0.3** | **0.2** | **1.2** | **0.1** | **0.3** | **0.3** | **0.5** |
| 033 | 033-v1a-082406 | 0.3 | 2.9 | **0.2** | **0.2** | **1.1** | 13.4 | 1.0 | 9.4 | **0.4** |
| 033 | 033-v1a-082506 | 0.1 | 2.5 | **0.2** | **0.2** | **1.1** | 12.0 | 0.8 | 6.4 | **0.4** |
| 033 | 033-v1a-082606 | 1.4 | 5.7 | **0.2** | **0.2** | **1.2** | 21.3 | 3.0 | 38.9 | **0.4** |

Volatile organic compound, sample IDs and concentrations.

| Home ID | Sample ID | Naph ($\mu g/m^3$) | Phen ($\mu g/m^3$) | aIP ($\mu g/m^3$) | Styr ($\mu g/m^3$) | TChlr ($\mu g/m^3$) | Tolu ($\mu g/m^3$) | Clr ($\mu g/m^3$) | 124T ($\mu g/m^3$) | Viny ($\mu g/m^3$) | mpXy ($\mu g/m^3$) | oXyl ($\mu g/m^3$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 014 | 014-v1b-081406 | **0.14** | 1.11 | 0.34 | **0.22** | **0.32** | 0.83 | **0.34** | **0.23** | **0.39** | 0.84 | **0.22** |
| 014 | 014-v2b-081406 | **0.14** | 0.67 | **0.21** | **0.22** | **0.33** | 0.57 | **0.34** | **0.23** | **0.39** | **0.27** | **0.22** |
| 015 | 015-v1a-081406 | **0.14** | 0.90 | 0.11 | **0.22** | **0.32** | 0.34 | **0.34** | **0.23** | **0.39** | **0.26** | **0.22** |
| 016 | 016-v1b-081506 | **0.13** | 0.58 | 1.33 | **0.21** | **0.31** | 1.44 | **0.32** | **0.22** | **0.37** | **0.25** | **0.21** |
| 017 | 017-v1a-081506 | **0.14** | 0.46 | 0.50 | **0.23** | **0.34** | 2.43 | **0.35** | **0.24** | **0.40** | 0.32 | **0.23** |
| 017 | 017-v2b-081506 | **0.14** | 0.68 | **0.21** | **0.22** | **0.32** | 0.64 | **0.34** | **0.23** | **0.39** | 0.41 | **0.22** |
| 017 | 017-v1a-022107 | **0.16** | **0.45** | 2.42 | 0.16 | 0.20 | 4.09 | 0.65 | **0.26** | **0.44** | 0.38 | **0.25** |
| 017 | 017-v2a-022107 | **0.15** | 0.67 | **0.23** | **0.24** | **0.36** | 0.30 | **0.37** | **0.25** | **0.43** | **0.29** | **0.25** |
| 018 | 018-v1a-081506 | **0.13** | 0.41 | 1.46 | **0.20** | **0.29** | 1.44 | **0.31** | **0.21** | **0.35** | **0.24** | **0.20** |
| 018 | 018-v1bd-081506 | **0.13** | 0.72 | 1.66 | **0.20** | **0.30** | 2.02 | **0.32** | **0.21** | **0.36** | 0.60 | **0.21** |
| 018 | 018-v1b-022107 | **0.15** | 0.31 | 2.12 | 0.68 | 27.93 | 1.86 | 1.30 | 0.17 | **0.41** | 0.31 | **0.24** |
| 019 | 019-v1a-081606 | **0.16** | 0.91 | 0.50 | **0.25** | **0.37** | 1.04 | **0.39** | **0.26** | **0.44** | 0.33 | **0.26** |
| 019 | 019-v1b-102406 | 0.27 | 0.86 | 8.77 | 0.32 | **0.30** | 12.89 | **0.32** | 1.83 | **0.36** | 6.03 | 1.87 |
| 019 | 019-v1b-022007 | 0.23 | 2.12 | 12.02 | 1.36 | 0.70 | 11.52 | 0.43 | 2.08 | **0.39** | 6.56 | 2.26 |
| 019 | 019-v1bd-022007 | 0.23 | 1.88 | 11.91 | 1.45 | 0.70 | 11.84 | 0.53 | 2.07 | **0.41** | 6.59 | 2.00 |
| 020 | 020-v1b-081606 | 0.57 | 5.32 | 25.18 | 4.47 | **0.30** | 50.79 | **0.31** | 9.65 | **0.36** | 27.93 | 10.33 |
| 020 | 020-v2b-081606 | **0.15** | 0.54 | **0.22** | **0.23** | **0.34** | 1.07 | **0.36** | **0.24** | **0.41** | 1.51 | **0.24** |
| 021 | 021-v1a-081606 | 0.25 | 5.41 | 35.29 | 2.42 | 2.08 | 12.26 | **0.34** | 0.60 | **0.39** | 7.70 | 1.93 |
| 022 | 022-v1b-081706 | **0.16** | 1.40 | 13.55 | 1.59 | **0.37** | 5.87 | **0.38** | 0.18 | **0.44** | 3.44 | 0.46 |
| 023 | 023-v1b-081706 | **0.15** | 3.82 | 33.02 | 2.13 | 5.03 | 9.52 | 0.71 | **0.25** | **0.43** | 3.31 | 0.59 |
| 023 | 023-v2a-081706 | **0.14** | 1.15 | **0.22** | **0.23** | **0.34** | 1.26 | **0.35** | **0.24** | **0.40** | 0.80 | **0.23** |
| 024 | 024-v1b-081706 | **0.15** | 1.39 | 18.52 | 0.61 | **0.35** | 4.16 | **0.37** | **0.25** | **0.42** | 2.37 | 0.20 |
| 025 | 025-v1a-082106 | **0.14** | 1.06 | 1.60 | 0.69 | **0.33** | 4.98 | **0.34** | **0.23** | **0.39** | 2.79 | 0.31 |
| 025 | 025-v1b-022107 | 0.13 | 1.39 | 6.30 | 0.61 | **0.31** | 12.94 | 1.01 | 0.47 | **0.37** | 1.32 | 0.46 |
| 026 | 026-v1a-082106 | **0.14** | 2.09 | 6.33 | 0.44 | **0.33** | 5.72 | **0.35** | **0.24** | **0.40** | 1.59 | **0.23** |
| 026 | 026-v2a-082106 | **0.14** | 1.54 | **0.21** | 0.12 | **0.33** | 0.94 | **0.34** | **0.23** | **0.39** | 1.32 | **0.22** |
| 027 | 027-v1a-082106 | 0.09 | 2.41 | 7.18 | 1.28 | **0.32** | 8.01 | **0.33** | 0.57 | **0.38** | 5.78 | 1.49 |
| 029 | 029-v1a-082206 | 0.15 | 1.82 | 39.37 | 1.48 | **0.32** | 5.65 | 0.22 | 3.47 | **0.38** | 3.10 | 0.46 |
| 029 | 029-v2a-082206 | **0.16** | 0.83 | **0.24** | **0.25** | **0.37** | 1.82 | **0.38** | **0.26** | **0.44** | 1.33 | **0.25** |
| 030 | 030-v1a-082206 | 0.39 | 2.26 | 19.45 | 0.86 | **0.33** | 43.81 | **0.34** | 4.78 | **0.39** | 21.71 | 6.87 |
| 030 | 030-v1ad-082206 | 0.37 | 2.04 | 18.60 | 1.22 | **0.32** | 41.67 | **0.33** | 4.66 | **0.38** | 21.60 | 6.95 |
| 031 | 031-v1b-082306 | 0.15 | 3.42 | 19.51 | 0.78 | **0.33** | 21.11 | **0.34** | 2.42 | **0.39** | 10.97 | 3.45 |
| 032 | 032-v1b-082306 | 0.09 | 1.33 | 3.52 | 0.63 | **0.34** | 10.97 | **0.36** | 1.69 | **0.41** | 8.60 | 2.53 |
| 032 | 032-v2b-082306 | **0.15** | 1.55 | **0.23** | 0.31 | **0.35** | 2.10 | **0.37** | **0.25** | **0.42** | 2.05 | 0.15 |
| 033 | 033-v1a-082406 | 0.13 | 1.77 | 15.92 | 0.92 | **0.30** | 9.78 | 2.17 | 0.82 | **0.36** | 4.14 | 0.95 |
| 033 | 033-v1a-082506 | 0.11 | 1.78 | 11.41 | 0.23 | **0.32** | 8.07 | 0.66 | 0.45 | **0.39** | 2.60 | 0.29 |
| 033 | 033-v1a-082606 | 0.18 | 2.40 | 26.21 | 0.79 | 0.28 | 16.81 | 5.40 | 1.15 | **0.41** | 5.43 | 1.20 |

Volatile organic compound, sample IDs and concentrations.

| Home ID | Sample ID | Benz ($\mu g/m^3$) | 2Bto ($\mu g/m^3$) | Capr ($\mu g/m^3$) | **Dchl** ($\mu g/m^3$) | Ethy ($\mu g/m^3$) | Hxan ($\mu g/m^3$) | nHex ($\mu g/m^3$) | dLim ($\mu g/m^3$) | Mepy ($\mu g/m^3$) |
|---|---|---|---|---|---|---|---|---|---|---|
| 034 | 034-v1a-082406 | **0.28** | **0.15** | **0.27** | **0.23** | **1.29** | 2.70 | **0.33** | 0.58 | 1.89 |
| 034 | 034-v2b-082406 | **0.26** | **0.14** | **0.25** | **0.21** | **1.20** | 0.17 | **0.31** | **0.31** | **0.44** |
| 037 | 037-v1a-090506 | **0.26** | 24.61 | **0.25** | 0.23 | 6.87 | 6.65 | 0.80 | 4.97 | 0.39 |
| 038 | 038-v1a-090506 | **0.25** | 8.46 | **0.24** | 0.23 | 24.74 | 49.18 | 0.82 | 13.42 | **0.43** |
| 038 | 038-v2a-090506 | **0.24** | **0.13** | 0.16 | 0.13 | **1.12** | 0.19 | 0.35 | **0.29** | **0.41** |
| 038 | 038-v1b-012407 | 0.51 | 1.35 | **0.25** | **0.22** | **1.21** | 4.00 | 0.26 | 5.91 | **0.44** |
| 039 | 039-v1a-090506 | 0.28 | 7.46 | **0.24** | **0.21** | 12.41 | 30.38 | 1.05 | 10.06 | **0.44** |
| 039 | 039-v1a-012407 | 1.19 | 5.60 | **0.23** | **0.20** | **1.14** | 6.21 | **0.29** | 12.49 | **0.42** |
| 040 | 040-v1a-090606 | 2.05 | 7.00 | **0.24** | 0.41 | 17.51 | 5.85 | 0.73 | 9.15 | **0.43** |
| 041 | 041-v1b-090606 | **0.23** | 2.45 | **0.22** | 0.10 | 26.85 | 13.26 | 0.96 | 7.50 | **0.39** |
| 041 | 041-v2a-090606 | **0.26** | 0.67 | **0.24** | 0.12 | **1.19** | 0.37 | 0.68 | **0.31** | **0.44** |
| 041 | 041-v1a-012507 | 1.22 | 31.78 | **0.26** | **0.23** | 8.48 | 7.55 | **0.33** | 7.70 | **0.47** |
| 041 | 041-v2b-012507 | 1.00 | **0.14** | **0.26** | **0.22** | 1.25 | 0.33 | 1.05 | 0.45 | **0.46** |
| 041 | 041-v1a-012607 | 1.27 | 4.42 | **0.25** | **0.21** | 11.77 | 8.72 | 1.24 | 5.83 | **0.44** |
| 041 | 041-v1a-012707 | 1.22 | 3.25 | **0.25** | **0.22** | 15.49 | 10.54 | 0.90 | 7.25 | **0.45** |
| 042 | 042-v1a-090606 | 4.58 | 3.40 | **0.23** | 2.56 | 32.64 | 22.00 | 6.88 | 19.35 | **0.41** |
| 043 | 043-v1a-090706 | **0.29** | 1.60 | **0.28** | 1.66 | 12.25 | 7.00 | 0.59 | 3.73 | **0.50** |
| 044 | 044-v1a-090706 | **0.24** | 3.56 | **0.23** | 0.13 | 4.39 | 2.57 | 0.69 | 0.91 | 0.72 |
| 044 | 044-v2b-090706 | **0.26** | 0.83 | **0.24** | 0.14 | **1.19** | 0.35 | 0.68 | **0.31** | **0.44** |
| 044 | 044-v1a-012607 | 1.68 | 2.82 | **0.24** | **0.21** | **1.18** | 8.30 | 0.72 | 20.74 | **0.43** |
| 044 | 044-v1ad-012607 | 1.63 | 2.55 | **0.26** | **0.23** | **1.26** | 7.79 | 0.68 | 20.23 | **0.46** |
| 045 | 045-v1a-090706 | 3.39 | 36.24 | **0.23** | **0.20** | 41.39 | 26.96 | 2.50 | 15.04 | 0.63 |
| 045 | 045-v1ad-090706 | 3.76 | 34.22 | **0.23** | **0.20** | 49.49 | 27.63 | 2.89 | 15.48 | 0.62 |
| 045 | 045-v1b-012307 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 046 | 046-v1a-090806 | 0.36 | 20.62 | **0.22** | **0.19** | 44.70 | 23.47 | 1.01 | 10.93 | **0.40** |
| 047 | 047-v1b-090806 | 4.53 | 13.99 | **0.23** | **0.20** | 21.00 | 20.41 | 5.23 | 7.78 | **0.41** |
| 047 | 047-v2b-090806 | **0.27** | **0.14** | **0.26** | **0.23** | **1.26** | 0.28 | 0.38 | **0.33** | **0.46** |
| 048 | 048-v1b-090806 | 1.43 | 10.95 | **0.23** | **0.20** | 17.16 | 10.85 | 1.72 | 3.35 | **0.42** |
| 049 | 049-v1a-091206 | **0.25** | 13.36 | **0.24** | 0.35 | 19.94 | 29.66 | 0.68 | 14.87 | **0.43** |
| 049 | 049-v1a-013007** | 0.92 | **0.14** | **0.25** | **0.22** | **1.21** | 12.31 | 0.55 | 23.36 | **0.44** |
| 049 | 049-v2a-013007 | 0.98 | **0.12** | **0.22** | **0.19** | **1.09** | 0.32 | 0.25 | **0.28** | **0.40** |
| 050 | 050-v1b-091206 | **0.26** | 1.74 | **0.24** | 0.16 | **1.19** | 1.91 | 0.84 | **0.31** | **0.44** |
| 050 | 050-v2b-091206 | **0.25** | 0.73 | **0.24** | 0.19 | **1.15** | **0.22** | 0.30 | **0.30** | **0.42** |
| 050 | 050-v1b-013007 | 3.88 | 1.48 | **0.23** | **0.20** | 6.11 | 11.84 | 6.72 | 40.20 | **0.42** |
| 053 | 053-v1a-091306 | **0.25** | 2.51 | **0.24** | **0.21** | **1.18** | 2.55 | **0.31** | **0.30** | **0.43** |
| 053 | 053-v2b-091306 | 0.27 | 0.14 | 0.26 | 0.22 | 1.24 | **0.37** | 0.32 | 0.32 | 0.46 |
| 054 | 054-v1b-091306 | **0.23** | 4.79 | **0.22** | **0.19** | 4.49 | 5.23 | **0.28** | 0.27 | **0.39** |
| 054 | 054-v1bd-091306 | **0.22** | 5.45 | **0.21** | **0.18** | 3.55 | 5.24 | **0.27** | 0.38 | **0.38** |

Volatile organic compound, sample IDs and concentrations.

| Home ID | Sample ID | Naph ($\mu g/m^3$) | Phen ($\mu g/m^3$) | alP ($\mu g/m^3$) | Styr ($\mu g/m^3$) | TChlr ($\mu g/m^3$) | Tolu ($\mu g/m^3$) | Clr ($\mu g/m^3$) | 124T ($\mu g/m^3$) | Viny ($\mu g/m^3$) | mpXy ($\mu g/m^3$) | oXyl ($\mu g/m^3$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 034 | 034-v1a-082406 | **0.16** | 0.91 | 2.35 | 0.13 | **0.37** | 4.41 | **0.38** | **0.26** | **0.44** | 1.84 | **0.25** |
| 034 | 034-v2b-082406 | **0.15** | 0.42 | **0.22** | **0.23** | **0.34** | **0.36** | **0.35** | **0.24** | **0.41** | **0.28** | **0.23** |
| 037 | 037-v1a-090506 | 0.49 | 1.83 | 14.81 | 2.86 | 0.56 | 8.44 | **0.36** | 1.50 | **0.41** | 3.63 | 1.22 |
| 038 | 038-v1a-090506 | 0.66 | 4.67 | 57.45 | 9.30 | **0.33** | 7.09 | 0.54 | 1.04 | **0.39** | 5.13 | 1.30 |
| 038 | 038-v2a-090506 | 0.16 | 1.34 | **0.21** | 0.51 | **0.32** | 2.25 | **0.33** | 0.60 | **0.38** | 1.56 | 0.47 |
| 038 | 038-v1b-012407 | 0.08 | 0.80 | 10.12 | 1.71 | **0.34** | 2.71 | 0.23 | 0.30 | **0.41** | 1.27 | 0.27 |
| 039 | 039-v1a-090506 | 0.30 | 2.44 | 25.63 | 3.72 | 3.64 | 8.24 | **0.35** | 1.12 | **0.40** | 9.52 | 2.11 |
| 039 | 039-v1a-012407 | 0.14 | 1.08 | 8.03 | 1.79 | 1.26 | 5.31 | **0.34** | 0.69 | **0.39** | 7.57 | 1.79 |
| 040 | 040-v1a-090606 | 0.26 | 2.26 | 12.65 | 1.96 | **0.33** | 6.92 | 0.43 | 0.96 | **0.40** | 4.77 | 1.44 |
| 041 | 041-v1b-090606 | 0.18 | 2.98 | 41.74 | 1.67 | **0.30** | 8.65 | **0.31** | 0.74 | **0.36** | 2.46 | 0.61 |
| 041 | 041-v2a-090606 | 0.17 | 0.87 | **0.22** | 0.75 | **0.34** | 3.13 | **0.35** | 0.75 | **0.40** | 2.22 | 0.66 |
| 041 | 041-v1a-012507 | **0.16** | 2.42 | 16.31 | 2.21 | **0.36** | 8.46 | 0.30 | 0.95 | **0.43** | 3.07 | 0.71 |
| 041 | 041-v2b-012507 | **0.15** | 0.96 | **0.23** | 0.27 | **0.36** | 2.93 | **0.37** | 0.42 | **0.42** | 1.36 | 0.40 |
| 041 | 041-v1a-012607 | **0.15** | 1.65 | 18.37 | 1.17 | **0.34** | 21.00 | **0.35** | 0.90 | **0.41** | 2.92 | 0.85 |
| 041 | 041-v1a-012707 | **0.15** | 2.45 | 19.60 | 1.21 | **0.35** | 13.87 | 0.19 | 1.05 | **0.41** | 3.20 | 0.68 |
| 042 | 042-v1a-090606 | 0.40 | 5.35 | 29.26 | 2.03 | **0.32** | 70.43 | 0.44 | 4.48 | **0.38** | 20.93 | 6.43 |
| 043 | 043-v1a-090706 | 0.25 | 1.35 | 10.31 | 0.47 | **0.38** | 5.32 | **0.40** | 0.64 | **0.46** | 1.69 | 0.54 |
| 044 | 044-v1a-090706 | 0.42 | 1.44 | 3.54 | 1.14 | **0.32** | 5.91 | **0.33** | 1.57 | **0.38** | 3.85 | 1.30 |
| 044 | 044-v2b-090706 | 0.19 | 0.68 | **0.22** | 0.18 | **0.34** | 3.59 | **0.35** | 0.90 | **0.40** | 2.33 | 0.76 |
| 044 | 044-v1a-012607 | 0.39 | 1.43 | 6.44 | 1.32 | **0.33** | 8.11 | **0.35** | 2.82 | **0.40** | 4.96 | 1.60 |
| 044 | 044-v1ad-012607 | 0.39 | 1.56 | 6.39 | 0.90 | **0.36** | 7.90 | **0.37** | 2.69 | **0.43** | 4.51 | 1.59 |
| 045 | 045-v1a-090706 | 2.51 | 6.46 | 49.26 | 4.42 | **0.31** | 23.43 | **0.33** | 4.13 | **0.38** | 13.14 | 3.73 |
| 045 | 045-v1ad-090706 | 2.40 | 6.38 | 51.61 | 4.42 | **0.32** | 24.02 | **0.33** | 4.08 | **0.38** | 13.14 | 3.74 |
| 045 | 045-v1b-012307 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 046 | 046-v1a-090806 | 0.30 | 4.70 | 35.35 | 2.91 | **0.31** | 10.90 | 0.22 | 1.03 | **0.37** | 3.63 | 0.91 |
| 047 | 047-v1b-090806 | 0.77 | 5.14 | 47.83 | 2.53 | **0.31** | 30.21 | **0.33** | 5.43 | **0.38** | 21.84 | 6.71 |
| 047 | 047-v2b-090806 | 0.18 | 0.02 | **0.23** | **0.24** | **0.36** | 2.69 | **0.37** | 0.68 | **0.43** | 1.89 | 0.62 |
| 048 | 048-v1b-090806 | 0.50 | 1.54 | 19.74 | 1.85 | **0.32** | 12.72 | **0.34** | 3.01 | **0.39** | 7.94 | 2.47 |
| 049 | 049-v1a-091206 | 0.40 | 3.93 | 31.24 | 2.83 | **0.33** | 13.26 | 0.26 | 0.86 | **0.40** | 3.83 | 1.25 |
| 049 | 049-v1a-013007 | 0.13 | 0.48 | 12.44 | 1.08 | **0.34** | 8.12 | **0.36** | 0.70 | **0.41** | 2.79 | 0.86 |
| 049 | 049-v2a-013007 | **0.13** | 0.53 | 0.20 | 0.17 | **0.31** | 3.75 | **0.32** | 0.61 | **0.37** | 2.22 | 0.75 |
| 050 | 050-v1b-091206 | 0.23 | 1.27 | 1.32 | 1.19 | **0.34** | 6.00 | **0.35** | 1.31 | **0.40** | 5.47 | 1.64 |
| 050 | 050-v2b-091206 | 0.18 | 0.54 | **0.21** | 0.62 | **0.33** | 2.17 | **0.34** | 0.68 | **0.39** | 2.17 | 0.61 |
| 050 | 050-v1b-013007 | 0.30 | 1.74 | 14.09 | 2.19 | 0.48 | 24.98 | 0.67 | 5.24 | **0.38** | 15.96 | 5.24 |
| 053 | 053-v1a-091306 | 0.13 | 0.61 | **0.22** | 0.21 | **0.33** | 0.96 | **0.35** | 0.30 | **0.40** | 0.73 | 0.19 |
| 053 | 053-v2b-091306 | **0.10** | **0.44** | 0.23 | **0.17** | 0.35 | 0.37 | 0.37 | **0.27** | 0.42 | **0.45** | 0.24 |
| 054 | 054-v1b-091306 | 0.16 | 0.80 | 1.91 | 0.76 | **0.30** | 4.15 | **0.32** | 0.48 | **0.36** | 2.02 | 0.57 |
| 054 | 054-v1bd-091306 | 0.15 | 1.03 | 1.92 | 0.44 | 0.29 | 4.36 | **0.30** | 0.48 | **0.35** | 1.95 | 0.58 |

Volatile organic compound, sample IDs and concentrations.

| Home ID | Sample ID | Benz ($\mu g/m^3$) | 2Bto ($\mu g/m^3$) | Capr ($\mu g/m^3$) | **Dchl** ($\mu g/m^3$) | Ethy ($\mu g/m^3$) | Hxan ($\mu g/m^3$) | nHex ($\mu g/m^3$) | dLim ($\mu g/m^3$) | Mepy ($\mu g/m^3$) |
|---|---|---|---|---|---|---|---|---|---|---|
| 055 | 055-v1a-091406 | **0.25** | 11.37 | **0.24** | **0.21** | 2.48 | 4.34 | **0.30** | 1.45 | **0.42** |
| 056 | 056-v1b-091406 | **0.27** | 3.65 | **0.26** | **0.22** | 0.85 | 8.11 | **0.32** | 3.08 | **0.46** |
| 056 | 056-v2a-091406 | **0.24** | **0.13** | **0.23** | **0.20** | **1.12** | 0.40 | **0.29** | **0.29** | **0.41** |
| 058 | 058-v1a-091506 | **0.26** | 23.86 | **0.25** | **0.22** | 11.61 | 6.12 | 0.26 | 2.41 | **0.32** |
| 058 | 058-v1a-013107 | 0.99 | 2.73 | **0.24** | **0.21** | 10.60 | 12.82 | 2.24 | 29.70 | 0.43 |
| 059 | 059-v1a-091506 | **0.25** | 0.94 | **0.23** | **0.20** | **1.14** | 2.26 | 0.32 | **0.29** | **0.42** |
| 059 | 059-v2b-091506 | **0.26** | 0.53 | **0.24** | **0.21** | **1.19** | 0.16 | **0.31** | **0.31** | **0.44** |
| 059 | 059-v1a-091606 | **0.29** | 1.12 | **0.27** | **0.24** | **1.33** | 3.40 | 1.03 | 0.28 | **0.49** |
| 059 | 059-v1b-091706 | 0.27 | 1.37 | **0.29** | **0.24** | **3.09** | 1.15 | 1.79 | **0.37** | **0.57** |
| 059 | 059-v1b-012907 | 3.85 | 0.98 | **0.25** | **0.21** | **1.20** | 4.12 | 3.48 | 5.21 | **0.44** |
| 059 | 059-v2b-012907 | 0.37 | **0.13** | **0.24** | **0.21** | **1.17** | 0.45 | **0.30** | **0.30** | **0.43** |
| 061 | 061-v1a-091806 | 1.55 | 4.90 | **0.27** | 0.81 | 36.06 | 13.13 | 1.77 | 14.79 | **0.54** |
| 062 | 062-v1b-091806 | 0.42 | 7.76 | **0.26** | **0.23** | 43.74 | 3.65 | 1.30 | 12.35 | **0.46** |
| 062 | 062-v2a-091806 | **0.26** | **0.14** | **0.25** | **0.22** | **1.21** | **0.10** | 0.90 | **0.31** | **0.44** |
| 062 | 062-v2ad-091806 | **0.25** | **0.13** | **0.24** | **0.21** | **1.17** | **0.10** | 0.51 | **0.30** | **0.43** |
| 062 | 062-v1a-012507 | 1.35 | 1.27 | **0.20** | **0.18** | 11.55 | 2.37 | 1.11 | 28.98 | **0.36** |
| 064 | 064-v1a-091906 | 1.79 | 1.61 | **0.26** | **0.23** | **1.27** | 4.40 | 4.73 | 2.53 | **0.47** |
| 064 | 064-v1ad-091906 | 1.77 | 2.20 | **0.27** | **0.24** | **1.31** | 4.80 | 5.21 | 2.56 | **0.48** |
| 065 | 065-v1a-091906 | 2.81 | 1.53 | **0.26** | 0.19 | 3.18 | 6.25 | 3.79 | 1.26 | **0.46** |
| 065 | 065-v2a-091906 | **0.27** | **0.15** | **0.26** | **0.23** | **1.27** | 0.49 | **0.33** | **0.33** | **0.47** |
| 066 | 066-v1a-091906 | **0.25** | 2.60 | **0.24** | **0.21** | 6.39 | 4.23 | 0.73 | 2.37 | **0.43** |
| 067 | 067-v1a-092006 | **0.26** | 1.45 | **0.25** | **0.21** | **1.20** | 2.36 | 0.71 | 2.11 | **0.44** |
| 068 | 068-v1a-092006 | **0.28** | 2.47 | **0.27** | **0.23** | 2.52 | 6.17 | 1.19 | 3.76 | **0.47** |
| 068 | 068-v2b-092006 | **0.25** | **0.14** | **0.24** | 0.40 | **1.18** | 0.58 | 0.24 | **0.30** | **0.43** |
| 069 | 069-v1a-092006 | 5.34 | 23.48 | **0.24** | **0.21** | 19.74 | 11.41 | 8.19 | 36.96 | **0.43** |
| 070 | 070-v1a-092106 | **0.28** | 2.25 | **0.26** | **0.23** | **1.28** | 2.57 | 0.87 | 1.33 | **0.47** |
| 071 | 071-v1a-092106 | 0.21 | 3.07 | **0.24** | 33.50 | 10.88 | 4.51 | 0.69 | 0.68 | **0.44** |
| 071 | 071-v2a-092106 | **0.26** | **0.14** | **0.25** | **0.21** | **1.20** | 0.48 | 0.33 | 0.61 | **0.44** |
| 072 | 072-v1a-092106 | **0.26** | 4.73 | **0.25** | **0.22** | 9.57 | 2.35 | 1.66 | 1.81 | **0.45** |
| 073 | 073-v1b-012307 | 0.69 | 0.60 | **0.24** | **0.21** | **1.19** | 2.34 | 0.66 | 21.89 | **0.44** |
| 073 | 073-v2a-012307 | 0.41 | **0.14** | **0.26** | **0.22** | **1.25** | **0.11** | **0.32** | **0.32** | **0.46** |
| 074 | 074-v1b-012307 | 2.41 | 0.25 | **0.24** | **0.21** | **1.15** | 3.42 | 4.09 | 10.08 | **0.42** |
| 075 | 075-v1a-012407 | 1.08 | 1.49 | **0.23** | **0.20** | 15.70 | 5.19 | 0.83 | 21.15 | **0.40** |
| 075 | 075-v2b-012407 | 0.68 | **0.11** | **0.20** | **0.18** | **0.99** | 0.21 | 0.19 | **0.25** | **0.36** |
| 076 | 076-v1b-012507 | 0.43 | 10.60 | **0.26** | 1.65 | **1.27** | 2.84 | 0.22 | 6.34 | **0.47** |
| 077 | 077-v1a-012607 | 1.20 | **0.14** | **0.24** | **0.21** | 12.43 | 8.49 | 1.09 | 16.61 | **0.43** |
| 077 | 077-v2b-012607 | **0.72** | **0.14** | **0.24** | **0.21** | **1.19** | **0.10** | 0.21 | **0.31** | **0.44** |
| 078 | 078-v1b-012907 | 1.13 | 0.45 | **0.24** | **0.21** | **1.15** | 4.20 | 0.90 | 15.46 | **0.42** |
| 078 | 078-v1bd-012907 | 1.31 | 0.58 | **0.24** | **0.21** | **1.15** | 4.64 | 1.00 | 17.22 | **0.42** |

Volatile organic compound, sample IDs and concentrations.

| Home ID | Sample ID | Naph ($\mu g/m^3$) | Phen ($\mu g/m^3$) | alP ($\mu g/m^3$) | Styr ($\mu g/m^3$) | TChlr ($\mu g/m^3$) | Tolu ($\mu g/m^3$) | Clr ($\mu g/m^3$) | 124T ($\mu g/m^3$) | Viny ($\mu g/m^3$) | mpXy ($\mu g/m^3$) | oXyl ($\mu g/m^3$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 055 | 055-v1a-091406 | 0.17 | 0.76 | 1.05 | 0.72 | **0.33** | 2.07 | **0.34** | 0.62 | **0.39** | 2.92 | 0.91 |
| 056 | 056-v1b-091406 | 0.20 | 1.30 | 6.35 | 0.59 | **0.36** | 1.81 | **0.37** | 0.57 | **0.42** | 1.62 | 0.56 |
| 056 | 056-v2a-091406 | 0.11 | 0.23 | **0.21** | 0.03 | **0.32** | **0.34** | **0.33** | 0.30 | **0.38** | 0.60 | 0.17 |
| 058 | 058-v1a-091506 | 0.26 | 2.39 | 7.52 | 1.28 | 0.88 | 2.33 | **0.36** | 0.52 | **0.41** | 2.82 | 0.91 |
| 058 | 058-v1a-013107 | 0.27 | 1.52 | 23.94 | 0.72 | 3.47 | 13.25 | 0.83 | 1.08 | **0.39** | 6.02 | 1.62 |
| 059 | 059-v1a-091506 | 0.15 | 0.32 | 0.33 | 0.14 | **0.32** | 2.91 | **0.34** | 0.85 | **0.39** | 2.41 | 0.74 |
| 059 | 059-v2b-091506 | 0.10 | 0.20 | **0.22** | **0.23** | **0.34** | **0.36** | **0.35** | 0.24 | **0.40** | 0.21 | **0.23** |
| 059 | 059-v1a-091606 | 0.28 | 1.06 | 0.41 | 0.60 | **0.38** | 7.02 | **0.39** | 2.00 | **0.45** | 5.83 | 2.01 |
| 059 | 059-v1b-091706 | 0.39 | 1.01 | 0.67 | 0.68 | **0.42** | 8.53 | **0.44** | 2.16 | **0.52** | 6.40 | 2.15 |
| 059 | 059-v1b-012907 | 1.06 | 0.72 | 1.64 | 1.21 | **0.34** | 29.22 | **0.35** | 17.92 | **0.41** | 32.88 | 13.97 |
| 059 | 059-v2b-012907 | **0.14** | 0.54 | **0.22** | 0.16 | **0.33** | 1.53 | **0.35** | 0.23 | **0.40** | 1.03 | 0.27 |
| 061 | 061-v1a-091806 | 0.59 | 4.49 | 25.65 | 3.51 | **0.40** | 8.28 | **0.42** | 1.89 | **0.49** | 6.16 | 1.80 |
| 062 | 062-v1b-091806 | 0.20 | 1.85 | 11.86 | 2.05 | **0.36** | 7.16 | 1.03 | 1.69 | **0.43** | 3.78 | 1.15 |
| 062 | 062-v2a-091806 | 0.15 | 0.31 | **0.22** | 0.71 | 0.34 | 2.30 | **0.36** | 1.01 | **0.41** | 2.52 | 0.66 |
| 062 | 062-v2ad-091806 | 0.14 | 0.39 | **0.22** | 0.33 | **0.33** | 2.00 | **0.35** | 0.59 | **0.40** | 1.49 | 0.39 |
| 062 | 062-v1a-012507 | 0.08 | 1.05 | 7.13 | 1.48 | 0.28 | 5.71 | 0.17 | 1.07 | **0.33** | 41.74 | 8.99 |
| 064 | 064-v1a-091906 | 0.28 | 0.97 | 7.79 | 0.67 | **0.36** | 16.85 | **0.38** | 3.13 | **0.43** | 10.89 | 3.77 |
| 064 | 064-v1ad-091906 | 0.32 | 1.13 | 8.33 | 1.86 | 0.40 | 18.51 | **0.39** | 3.94 | **0.44** | 13.82 | 4.42 |
| 065 | 065-v1a-091906 | 0.27 | 1.09 | 6.87 | 0.74 | 0.48 | 15.46 | 0.45 | 2.30 | **0.43** | 10.90 | 2.92 |
| 065 | 065-v2a-091906 | 0.14 | **0.21** | **0.23** | 0.16 | **0.36** | 0.97 | **0.38** | 0.54 | **0.43** | 1.68 | 0.41 |
| 066 | 066-v1a-091906 | 0.21 | 1.32 | 6.40 | 0.66 | 0.63 | 3.02 | **0.35** | 1.11 | **0.40** | 2.23 | 0.66 |
| 067 | 067-v1a-092006 | 0.14 | 0.60 | 3.88 | 0.29 | 0.29 | 3.39 | **0.35** | 1.04 | **0.41** | 3.29 | 1.03 |
| 068 | 068-v1a-092006 | 0.15 | 0.74 | 10.57 | 1.18 | **0.37** | 3.73 | **0.38** | 0.79 | **0.44** | 2.72 | 0.69 |
| 068 | 068-v2b-092006 | 0.14 | 0.43 | **0.22** | 0.71 | **0.33** | 2.14 | **0.35** | 0.72 | **0.40** | 2.82 | 0.72 |
| 069 | 069-v1a-092006 | 0.31 | 2.64 | 14.62 | 2.54 | 0.45 | 115.15 | 1.22 | 6.11 | **0.40** | 23.41 | 7.82 |
| 070 | 070-v1a-092106 | 0.16 | 1.17 | 4.03 | 0.57 | **0.36** | 6.68 | **0.38** | 1.31 | **0.43** | 5.48 | 1.57 |
| 071 | 071-v1a-092106 | **0.14** | 2.17 | 5.14 | 0.33 | **0.34** | 4.59 | **0.35** | 0.52 | **0.40** | 1.09 | 0.28 |
| 071 | 071-v2a-092106 | **0.15** | 0.42 | **0.22** | **0.23** | **0.34** | 0.89 | **0.35** | 0.55 | **0.41** | 0.77 | 0.22 |
| 072 | 072-v1a-092106 | 0.15 | 0.20 | 4.62 | 0.16 | **0.35** | 4.40 | **0.36** | 1.01 | **0.41** | 2.16 | 0.81 |
| 073 | 073-v1b-012307 | 0.07 | 1.41 | 7.58 | 0.26 | 3.61 | 4.80 | **0.35** | 0.38 | **0.40** | 1.76 | 0.52 |
| 073 | 073-v2a-012307 | **0.15** | 0.50 | **0.23** | **0.24** | **0.36** | 0.60 | **0.37** | **0.25** | **0.42** | 0.37 | **0.24** |
| 074 | 074-v1b-012307 | **0.14** | 0.59 | 8.04 | 61.95 | 0.39 | 13.98 | **0.34** | 0.72 | **0.39** | 3.56 | 1.14 |
| 075 | 075-v1a-012407 | 0.84 | 1.72 | 9.83 | 0.83 | 22.59 | 8.29 | 0.72 | 1.80 | **0.37** | 3.66 | 1.14 |
| 075 | 075-v2b-012407 | **0.12** | 0.50 | **0.18** | **0.19** | **0.28** | 1.38 | **0.29** | 0.28 | **0.33** | 1.41 | 0.40 |
| 076 | 076-v1b-012507 | **0.16** | 0.72 | 4.96 | 0.59 | **0.36** | 3.60 | 0.94 | 2.49 | **0.43** | 6.66 | 2.54 |
| 077 | 077-v1a-012607 | 0.65 | 1.74 | 22.33 | 2.15 | **0.33** | 6.34 | **0.35** | 2.11 | **0.40** | 3.19 | 0.48 |
| 077 | 077-v2b-012607 | **0.14** | 0.41 | **0.22** | **0.23** | **0.34** | 1.66 | **0.35** | 0.21 | **0.40** | 0.88 | 0.24 |

Volatile organic compound, sample IDs and concentrations.

| Home ID | Sample ID | Benz ($\mu g/m^3$) | 2Bto ($\mu g/m^3$) | Capr ($\mu g/m^3$) | **Dchl** ($\mu g/m^3$) | Ethy ($\mu g/m^3$) | Hxan ($\mu g/m^3$) | nHex ($\mu g/m^3$) | dLim ($\mu g/m^3$) | Mepy ($\mu g/m^3$) |
|---|---|---|---|---|---|---|---|---|---|---|
| 079 | 079-v1b-012907 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 080 | 080-v1a-013007 | 3.70 | 4.27 | **0.23** | 0.24 | **1.13** | 11.63 | 2.96 | 29.03 | **0.42** |
| 081 | 081-v1a-013107 | 15.14 | 0.68 | **0.24** | **0.21** | 9.74 | 10.97 | 24.03 | 14.88 | **0.43** |
| 081 | 081-v2b-013107 | 0.30 | **0.14** | **0.25** | **0.22** | **1.23** | **0.11** | **0.32** | **0.32** | **0.45** |
| 083 | 083-v1b-020107 | 1.87 | 0.27 | **0.25** | **0.22** | **1.21** | 6.09 | 0.96 | 14.19 | **0.45** |
| 083 | 083-v1ad-020107 | 1.84 | 0.27 | **0.23** | **0.20** | **1.13** | 4.80 | 0.82 | 13.31 | **0.42** |
| 084 | 084-v1b-020107 | 1.31 | 2.21 | **0.26** | **0.22** | 7.04 | 9.53 | 0.58 | 15.76 | **0.46** |
| 084 | 084-v2a-020107 | 0.87 | **0.13** | **0.22** | **0.20** | **1.09** | **0.09** | 0.18 | **0.28** | **0.40** |
| 085 | 085-v1b-020107 | 2.04 | 0.87 | **0.24** | **0.21** | 13.53 | 4.56 | 0.76 | 14.17 | **0.44** |
| 086 | 086-v1a-020507 | 4.66 | 10.03 | **0.25** | **0.22** | **1.22** | 12.40 | 6.47 | 49.84 | 0.42 |
| 086 | 086-v1ad-020507 | 4.76 | 11.68 | **0.25** | **0.22** | **1.22** | 13.10 | 7.54 | 51.77 | 0.38 |
| 087 | 087-v1a-020507 | 3.46 | 0.41 | **0.24** | **0.21** | **1.18** | 1.41 | 4.69 | 8.41 | **0.43** |
| 087 | 087-v2a-020507 | 1.40 | **0.14** | **0.25** | **0.22** | **1.21** | **0.10** | 0.92 | **0.31** | **0.44** |
| 088 | 088-v1a-020507 | 0.98 | **0.13** | **0.24** | **0.21** | **1.17** | 9.34 | 0.74 | 5.31 | **0.43** |
| 089 | 089-v1b-020607 | 1.23 | 0.21 | **0.24** | 7.91 | 7.31 | 1.44 | 1.07 | 5.14 | **0.44** |
| 090 | 090-v1b-020607 | 2.47 | 1.07 | **0.24** | 0.11 | **1.15** | 3.08 | 3.50 | 11.26 | **0.42** |
| 090 | 090-v2b-020607 | 2.06 | **0.14** | **0.25** | **0.21** | **1.20** | 0.31 | 1.03 | **0.31** | **0.44** |
| 091 | 091-v1b-020607 | 3.48 | 1.95 | **0.23** | **0.20** | **1.12** | 7.82 | 3.11 | 7.68 | **0.41** |
| 092 | 092-v1b-020707 | 2.71 | 3.59 | **0.24** | 0.22 | 16.01 | 7.86 | 2.50 | 60.59 | **0.42** |
| 092 | 092-v2b-020707 | 1.75 | **0.13** | 0.34 | **0.21** | **1.17** | 0.12 | 1.10 | **0.30** | **0.43** |
| 092 | 092-v2ad-020707 | 1.85 | **0.14** | **0.24** | **0.21** | **1.18** | **0.10** | 1.34 | **0.30** | **0.43** |
| 093 | 093-v1a-020707 | 7.20 | 1.83 | **0.26** | **0.22** | 14.93 | 6.80 | 3.66 | 8.18 | **0.46** |
| 093 | 093-v1bd-020707 | 8.15 | 2.01 | **0.24** | **0.21** | 17.03 | 7.15 | 3.98 | 9.05 | **0.43** |
| 094 | 094-v1b-020807 | 1.62 | 4.21 | **0.24** | 75.60 | **1.18** | 4.05 | 1.11 | 11.32 | **0.43** |
| 095 | 095-v1a-020807 | 3.24 | 10.22 | **0.27** | **0.24** | **1.31** | 11.38 | 4.03 | 39.29 | **0.48** |
| 095 | 095-v2b-020807 | 1.36 | **0.15** | **0.27** | **0.24** | **1.32** | 0.18 | 0.82 | **0.34** | **0.49** |
| 096 | 096-v1a-020807 | 5.32 | 0.45 | **0.24** | **0.21** | **1.18** | 10.76 | 4.85 | 18.52 | **0.43** |
| 097 | 097-v1a-022007 | 0.80 | 1.24 | **0.24** | 218.95 | **1.17** | 4.28 | 0.33 | 20.61 | **0.43** |
| 098 | 098-v1a-022007 | 1.06 | 5.79 | **0.24** | 0.37 | 26.42 | 15.58 | 1.23 | 23.16 | **0.43** |
| 098 | 098-v2b-022007 | 0.68 | **0.14** | **0.25** | **0.21** | **1.20** | **0.10** | **0.31** | **0.31** | **0.44** |
| 099 | 099-v1a-022207 | 2.45 | 6.33 | **0.23** | 0.26 | 14.16 | 29.89 | 2.97 | 24.10 | **0.41** |
| 099 | 099-v2a-022207 | 0.75 | **0.13** | **0.23** | **0.20** | **1.12** | **0.10** | 0.17 | **0.29** | **0.41** |
| 099 | 099-v1a-022307 | 3.03 | 4.75 | **0.20** | 0.12 | 10.73 | 27.65 | 4.38 | 29.10 | **0.35** |
| 099 | 099-v1a-022407 | 2.77 | 4.83 | **0.24** | 0.12 | 12.86 | 28.73 | 4.47 | 28.79 | **0.43** |
| 101 | 101-v1b-022207 | 0.80 | 1.56 | **0.26** | **0.23** | **1.28** | 12.95 | 0.22 | 14.98 | **0.47** |
| 102 | 102-v1a-022307 | 1.37 | 2.82 | **0.23** | **0.20** | **1.13** | 24.68 | 0.64 | 17.64 | **0.42** |
| 104 | 104-v1b-022307 | 1.10 | 1.13 | **0.24** | **0.21** | 8.80 | 3.54 | 0.80 | 6.26 | **0.43** |
| 104 | 104-v2b-022307 | 0.93 | **0.13** | **0.23** | **0.20** | **1.11** | 0.31 | 0.24 | **0.29** | **0.41** |

Volatile organic compound, sample IDs and concentrations.

| Home ID | Sample ID | Naph (μg/m$^3$) | Phen (μg/m$^3$) | alP (μg/m$^3$) | Styr (μg/m$^3$) | TChlr (μg/m$^3$) | Tolu (μg/m$^3$) | Clr (μg/m$^3$) | 124T (μg/m$^3$) | Viny (μg/m$^3$) | mpXy (μg/m$^3$) | oXyl (μg/m$^3$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 078 | 078-v1b-012907 | 0.10 | 0.44 | 12.01 | 0.31 | **0.33** | 7.25 | 0.56 | 0.53 | **0.39** | 2.36 | 0.58 |
| 078 | 078-v1bd-012907 | 0.12 | 1.09 | 13.22 | 0.76 | **0.33** | 8.29 | 0.54 | 0.70 | **0.39** | 2.87 | 0.60 |
| 079 | 079-v1b-012907 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 080 | 080-v1a-013007 | 0.57 | 1.06 | 22.55 | 2.52 | 0.48 | 29.96 | 0.72 | 3.06 | **0.38** | 11.96 | 4.14 |
| 081 | 081-v1a-013107 | 0.38 | 2.59 | 20.68 | 1.18 | **0.33** | 53.78 | **0.35** | 8.36 | **0.40** | 32.70 | 10.56 |
| 081 | 081-v2b-013107 | **0.15** | 0.40 | **0.23** | **0.24** | **0.35** | **0.37** | **0.36** | **0.25** | **0.42** | **0.29** | **0.24** |
| 083 | 083-v1b-020107 | 0.14 | 0.84 | 10.79 | 1.48 | **0.34** | 8.20 | 1.78 | 1.32 | **0.41** | 4.55 | 1.19 |
| 083 | 083-v1ad-020107 | 0.13 | 0.58 | 10.95 | 0.77 | **0.32** | 8.28 | 2.09 | 1.18 | **0.38** | 4.06 | 1.17 |
| 084 | 084-v1b-020107 | 0.18 | 1.50 | 11.71 | 1.58 | **0.35** | 7.73 | **0.37** | 1.05 | **0.42** | 3.68 | 1.04 |
| 084 | 084-v2a-020107 | **0.13** | 0.25 | 0.33 | **0.21** | **0.31** | 1.78 | **0.32** | 0.34 | **0.37** | 1.12 | 0.36 |
| 085 | 085-v1b-020107 | 0.20 | 1.63 | 11.59 | 0.94 | **0.34** | 8.45 | 0.30 | 1.34 | **0.40** | 6.15 | 1.88 |
| 086 | 086-v1a-020507 | 0.35 | 1.08 | 37.65 | 0.89 | **0.35** | 43.88 | 1.17 | 6.62 | **0.41** | 20.47 | 6.18 |
| 086 | 086-v1ad-020507 | 0.33 | 1.30 | 40.05 | 0.93 | **0.35** | 44.78 | 1.21 | 6.86 | **0.41** | 21.00 | 7.02 |
| 087 | 087-v1a-020507 | 0.18 | 0.59 | 6.99 | 0.87 | 0.28 | 26.84 | **0.35** | 1.95 | **0.40** | 9.16 | 2.72 |
| 087 | 087-v2a-020507 | **0.15** | 0.25 | 0.18 | **0.23** | **0.34** | 4.51 | **0.36** | 0.69 | **0.41** | 2.41 | 0.83 |
| 088 | 088-v1a-020507 | **0.18** | 1.47 | 22.57 | 0.87 | **0.33** | 8.34 | **0.35** | 1.44 | **0.40** | 2.58 | 0.55 |
| 089 | 089-v1b-020607 | 0.14 | 1.49 | 6.64 | 0.58 | 0.46 | 4.20 | 0.32 | 0.80 | **0.40** | 2.17 | 0.59 |
| 090 | 090-v1b-020607 | 0.18 | 0.52 | 7.18 | 0.60 | 0.32 | 18.64 | **0.34** | 2.11 | **0.39** | 7.98 | 2.68 |
| 090 | 090-v2b-020607 | **0.15** | 0.37 | 0.15 | 0.05 | 0.41 | 5.06 | **0.35** | 0.81 | **0.41** | 2.68 | 0.90 |
| 091 | 091-v1b-020607 | 0.26 | 2.64 | 11.09 | 1.67 | 0.28 | 30.26 | 0.74 | 2.39 | **0.38** | 11.09 | 3.75 |
| 092 | 092-v1b-020707 | 0.22 | 1.79 | 11.77 | 1.21 | 0.44 | 94.47 | 1.16 | 1.58 | **0.39** | 6.17 | 1.98 |
| 092 | 092-v2b-020707 | 0.11 | 0.40 | **0.22** | 0.25 | 0.44 | 6.33 | **0.35** | 0.95 | **0.40** | 3.26 | 1.12 |
| 092 | 092-v2ad-020707 | 0.11 | 0.25 | **0.22** | 0.10 | 0.47 | 6.57 | **0.35** | 0.99 | **0.40** | 3.29 | 1.14 |
| 093 | 093-v1a-020707 | 0.22 | 1.66 | 18.76 | 1.35 | 0.41 | 20.00 | **0.18** | 2.75 | 0.42 | 10.40 | 2.86 |
| 093 | 093-v1bd-020707 | 0.27 | 1.43 | 20.99 | 1.57 | 0.49 | 22.96 | 0.20 | 3.13 | **0.40** | 11.88 | 3.58 |
| 094 | 094-v1b-020807 | 0.17 | 1.71 | 5.35 | 0.98 | 1.00 | 13.82 | **0.35** | 1.10 | **0.40** | 4.21 | 1.27 |
| 095 | 095-v1a-020807 | 0.10 | 0.88 | 12.49 | 1.52 | **0.37** | 18.29 | **0.39** | 2.05 | **0.44** | 9.28 | 2.79 |
| 095 | 095-v2b-020807 | **0.16** | 0.70 | **0.24** | 0.17 | 0.22 | 4.28 | **0.39** | 0.68 | **0.45** | 2.29 | 0.73 |
| 096 | 096-v1a-020807 | 0.32 | 1.76 | 43.15 | 1.78 | 0.27 | 19.62 | 0.89 | 2.28 | **0.40** | 9.79 | 2.45 |
| 097 | 097-v1a-022007 | 0.13 | 1.61 | 6.76 | 0.36 | **0.33** | 5.74 | **0.35** | 0.60 | **0.40** | 2.13 | 0.79 |
| 098 | 098-v1a-022007 | 0.28 | 2.00 | 11.21 | 0.84 | **0.33** | 16.04 | **0.35** | 3.11 | **0.40** | 12.61 | 3.97 |
| 098 | 098-v2b-022007 | **0.15** | 0.36 | **0.22** | **0.23** | **0.34** | 0.99 | **0.35** | 0.14 | **0.41** | 0.60 | 0.14 |
| 099 | 099-v1a-022207 | 0.63 | 2.24 | 14.93 | 0.81 | 0.22 | 16.10 | 4.34 | 4.24 | **0.38** | 9.16 | 3.54 |
| 099 | 099-v2a-022207 | **0.14** | 0.36 | **0.21** | **0.21** | **0.32** | 1.06 | **0.33** | 0.16 | **0.38** | 0.66 | 0.18 |
| 099 | 099-v1a-022307 | 0.60 | 2.49 | 15.21 | 1.09 | 0.21 | 20.58 | 4.51 | 4.31 | **0.32** | 10.46 | 3.94 |
| 099 | 099-v1a-022407 | 0.62 | 2.38 | 14.61 | 1.06 | **0.33** | 18.90 | 3.60 | 5.62 | **0.40** | 12.42 | 4.96 |
| 101 | 101-v1b-022207 | 0.15 | 2.00 | 9.12 | 0.39 | **0.36** | 7.30 | 2.31 | 0.35 | **0.43** | 1.52 | 0.27 |
| 102 | 102-v1a-022307 | 0.64 | 1.95 | 39.13 | 2.46 | **0.32** | 17.81 | 5.65 | 3.76 | **0.38** | 2.61 | 0.46 |
| 104 | 104-v1b-022307 | 0.09 | 0.76 | 6.62 | 0.57 | **0.33** | 12.76 | 2.11 | 0.47 | **0.39** | 2.71 | 0.65 |

Volatile organic compound, sample IDs and concentrations.

| Home ID | Sample ID | Benz ($\mu g/m^3$) | 2Bto ($\mu g/m^3$) | Capr ($\mu g/m^3$) | **Dchl** ($\mu g/m^3$) | Ethy ($\mu g/m^3$) | Hxan ($\mu g/m^3$) | nHex ($\mu g/m^3$) | dLim ($\mu g/m^3$) | Mepy ($\mu g/m^3$) |
|---|---|---|---|---|---|---|---|---|---|---|
| 105 | 105-v1b-022707 | 1.50 | 4.50 | **0.23** | **0.20** | 4.86 | 17.13 | 2.26 | 17.08 | **0.41** |
| 106 | 106-v1a-022807 | 1.77 | 9.83 | **0.23** | 0.48 | 6.65 | 10.93 | 1.77 | 19.41 | **0.41** |
| 107 | 107-v1b-022807 | 1.02 | 0.57 | **0.21** | 0.13 | **1.04** | 13.98 | 0.52 | 29.64 | **0.38** |
| 107 | 107-v2b-022807 | 0.86 | **0.13** | **0.24** | **0.21** | **1.15** | **0.10** | **0.30** | **0.30** | **0.42** |
| 107 | 107-v2ad-022807 | 0.86 | **0.13** | **0.24** | **0.21** | **1.15** | **0.10** | 0.19 | **0.30** | **0.42** |
| 108 | 108-v1b-022807 | 11.94 | 14.32 | **0.25** | **0.21** | **1.20** | 13.23 | 20.48 | 10.42 | 2.09 |
| 109 | 109-v1a-030207 | 1.37 | 4.28 | **0.24** | **0.21** | 17.25 | 22.00 | 0.86 | 17.02 | **0.43** |
| 110 | 110-v1a-030207 | 2.22 | 0.76 | **0.21** | 1.63 | **1.04** | 5.16 | 0.74 | 15.53 | **0.38** |
| 110 | 110-v2b-030207 | 0.60 | **0.13** | **0.22** | **0.20** | **1.09** | 0.33 | **0.28** | 0.38 | **0.40** |
| 112 | 112-v1b-030507 | 0.79 | 2.20 | **0.23** | 1.03 | **1.12** | 5.47 | 0.42 | 57.16 | **0.41** |
| 112 | 112-v2b-030507 | **0.46** | 0.14 | 0.25 | 0.22 | 1.22 | **0.61** | 0.32 | **0.16** | 0.45 |
| 113 | 113-v1a-030507 | 3.37 | 7.97 | **0.23** | 0.63 | **1.12** | 14.03 | 6.32 | 152.25 | **0.41** |
| 114 | 114-v1b-030607 | 2.51 | 49.43 | **0.25** | **0.22** | **1.21** | 32.80 | 1.56 | 37.31 | **0.45** |
| 115 | 115-v1b-030607 | 1.88 | 179.68 | **0.24** | **0.21** | **1.16** | 20.03 | 0.70 | 73.01 | **0.43** |
| 115 | 115-v2b-030607 | 0.49 | **0.13** | **0.24** | **0.21** | **1.15** | 0.50 | **0.30** | **0.30** | **0.42** |
| 116 | 116-v1a-030607 | 0.93 | 3.34 | **0.23** | **0.20** | **1.14** | 11.56 | 0.84 | 26.05 | 0.72 |
| 116 | 116-v1bd-030607 | 0.82 | 4.27 | **0.25** | **0.21** | **1.20** | 11.22 | 0.73 | 22.33 | 0.64 |
| 117 | 117-v1a-030707 | 1.99 | 7.91 | **0.24** | **0.21** | **1.15** | 27.88 | 18.90 | 105.40 | **0.42** |
| 118 | 118-v1b-030707 | 1.18 | 4.09 | **0.24** | **0.21** | **1.18** | 23.94 | 1.31 | 24.48 | **0.43** |
| 118 | 118-v2b-030707 | 0.37 | **0.14** | **0.25** | **0.21** | **1.20** | 0.47 | **0.31** | **0.31** | **0.44** |
| 119 | 119-v1a-030707 | 1.65 | 4.97 | **0.26** | **0.22** | **1.24** | 21.25 | 2.49 | 124.62 | 0.25 |
| 120 | 120-v1b-030807 | 0.79 | 14.17 | **0.25** | **0.21** | **1.20** | 18.73 | 0.26 | 17.86 | **0.44** |
| 121 | 121-v1b-030807 | 0.69 | **0.14** | **0.25** | **0.22** | **1.21** | 19.62 | 0.40 | 90.44 | **0.44** |
| 121 | 121-v2a-030807 | 0.55 | **0.13** | **0.23** | **0.20** | **1.10** | **0.09** | **0.28** | **0.28** | **0.40** |
| 121 | 121-v2ad-030807 | 0.49 | **0.14** | **0.25** | **0.22** | **1.21** | **0.10** | **0.31** | **0.31** | **0.44** |

Volatile organic compound, sample IDs and concentrations.

| Home ID | Sample ID | Naph (μg/m$^3$) | Phen (μg/m$^3$) | alP (μg/m$^3$) | Styr (μg/m$^3$) | TChlr (μg/m$^3$) | Tolu (μg/m$^3$) | Clr (μg/m$^3$) | 124T (μg/m$^3$) | Viny (μg/m$^3$) | mpXy (μg/m$^3$) | oXyl (μg/m$^3$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 104 | 104-v2b-022307 | **0.14** | 0.85 | **0.20** | **0.21** | **0.31** | 1.76 | **0.33** | 0.29 | **0.38** | 1.10 | 0.32 |
| 105 | 105-v1b-022707 | 0.13 | 2.74 | 10.35 | 0.60 | **0.31** | 11.25 | **0.33** | 1.80 | **0.38** | 5.82 | 1.81 |
| 106 | 106-v1a-022807 | 0.47 | 2.72 | 7.99 | 0.85 | 2.26 | 13.82 | 1.46 | 2.38 | **0.38** | 11.57 | 3.93 |
| 107 | 107-v1b-022807 | 0.24 | 2.25 | 6.86 | 0.90 | **0.29** | 13.81 | 1.56 | 1.49 | **0.35** | 2.35 | 0.93 |
| 107 | 107-v2b-022807 | **0.14** | 0.48 | **0.21** | **0.22** | **0.33** | 1.14 | **0.34** | 0.17 | **0.39** | 0.68 | 0.19 |
| 107 | 107-v2ad-022807 | **0.14** | 0.35 | **0.21** | **0.22** | **0.33** | 1.13 | **0.34** | 0.17 | **0.39** | 0.67 | 0.20 |
| 108 | 108-v1b-022807 | 0.47 | 1.18 | 9.47 | 0.65 | **0.34** | 99.92 | 0.82 | 13.16 | **0.41** | 60.26 | 19.85 |
| 109 | 109-v1a-030207 | 1.06 | 2.49 | 20.33 | 1.33 | 0.59 | 33.89 | **0.35** | 2.22 | 0.26 | 11.79 | 3.35 |
| 110 | 110-v1a-030207 | 0.12 | 1.41 | 8.89 | 0.69 | **0.29** | 16.17 | **0.31** | 0.79 | **0.35** | 4.47 | 1.23 |
| 110 | 110-v2b-030207 | **0.13** | 0.34 | **0.20** | **0.21** | **0.31** | 1.13 | **0.32** | 0.14 | **0.37** | 0.59 | 0.15 |
| 112 | 112-v1b-030507 | 4.85 | 1.21 | 8.70 | 0.63 | **0.32** | 4.71 | 0.78 | 0.73 | **0.38** | 2.30 | 0.62 |
| 112 | 112-v2b-030507 | 0.15 | **0.73** | 0.23 | 0.23 | 0.35 | **0.96** | 0.36 | 0.25 | 0.41 | **0.45** | 0.24 |
| 113 | 113-v1a-030507 | 0.32 | 1.53 | 12.56 | 2.43 | 3.37 | 41.19 | 2.09 | 3.54 | **0.38** | 15.03 | 4.66 |
| 114 | 114-v1b-030607 | 0.33 | 3.20 | 20.18 | 1.73 | **0.34** | 22.55 | 1.56 | 1.68 | **0.41** | 5.65 | 1.20 |
| 115 | 115-v1b-030607 | 0.14 | 2.77 | 8.40 | 1.46 | 0.36 | 10.99 | 3.09 | 0.81 | **0.39** | 5.61 | 1.71 |
| 115 | 115-v2b-030607 | **0.14** | 0.62 | **0.21** | **0.22** | **0.33** | 1.06 | **0.34** | **0.23** | **0.39** | 0.51 | 0.12 |
| 116 | 116-v1a-030607 | 0.10 | 2.47 | 13.31 | 1.89 | 0.59 | 4.78 | 1.22 | 0.61 | **0.39** | 5.55 | 1.36 |
| 116 | 116-v1bd-030607 | 0.08 | 2.59 | 12.58 | 1.78 | 0.53 | 4.26 | 1.39 | 0.51 | **0.41** | 5.23 | 1.14 |
| 117 | 117-v1a-030707 | 0.14 | 2.78 | 23.45 | 3.66 | **0.33** | 41.62 | 2.44 | 2.82 | **0.39** | 28.96 | 7.07 |
| 118 | 118-v1b-030707 | 0.14 | 1.87 | 23.89 | 3.64 | **0.33** | 14.73 | 2.75 | 1.29 | **0.40** | 4.36 | 0.81 |
| 118 | 118-v2b-030707 | **0.15** | 0.61 | **0.22** | **0.23** | **0.34** | 0.77 | **0.35** | **0.24** | **0.41** | 0.44 | **0.23** |
| 119 | 119-v1a-030707 | 0.18 | 1.26 | 10.01 | 3.24 | **0.35** | 13.06 | 0.44 | 1.82 | **0.42** | 5.99 | 1.85 |
| 120 | 120-v1b-030807 | 0.26 | 4.87 | 16.36 | 1.23 | **0.34** | 9.74 | 11.82 | 0.68 | **0.41** | 3.73 | 0.97 |
| 121 | 121-v1b-030807 | 0.24 | 3.27 | 15.99 | 0.88 | **0.34** | 6.82 | 0.68 | 1.02 | **0.41** | 2.21 | 0.62 |
| 121 | 121-v2a-030807 | **0.13** | 0.50 | **0.20** | **0.21** | **0.31** | 0.78 | **0.33** | **0.22** | **0.37** | 0.38 | **0.21** |
| 121 | 121-v2ad-030807 | **0.15** | 0.52 | **0.22** | **0.23** | **0.34** | 0.69 | **0.36** | **0.24** | **0.41** | 0.32 | **0.23** |

Formaldehyde and acetaldehyde, sample IDs and concentrations.

| Home ID | Sample ID | Acetaldehyde ($\mu g/m^3$) | Formaldehyde ($\mu g/m^3$) | Home ID | Sample ID | Acetaldehyde ($\mu g/m^3$) | Formaldehyde ($\mu g/m^3$) |
|---|---|---|---|---|---|---|---|
| 001 | 001-f1-080706 | NA | NA | 017 | 017-f2-022107 | 0.19 | 2.00 |
| 002 | 002-f1-080706 | 2.83 | 7.99 | 018 | 018-f1-081506 | 3.86 | 11.73 |
| 002 | 002-f2-080706 | 3.14 | 1.33 | 018 | 018-f1d-081506 | 6.19 | 18.58 |
| 002 | 002-f1-030107 | 27.56 | 52.78 | 018 | 018-f1-022107 | 10.02 | 23.29 |
| 003 | 003-f1-080706 | 11.46 | 35.94 | 019 | 019-f1-081606 | 2.97 | 4.77 |
| 004 | 004-f1-080806 | 16.61 | 39.04 | 019 | 019-f1-102406 | 15.21 | 24.22 |
| 004 | 004-f1-030107 | 62.05 | 62.83 | 019 | 019-f1-022007 | 22.50 | 35.65 |
| 005 | 005-f1-080806 | 64.13 | 111.28 | 019 | 019-f1d-022007 | 21.57 | 33.26 |
| 005 | 005-f2-080806 | NA | NA | 020 | 020-f1-081606 | 27.07 | 92.69 |
| 005 | 005-f1-102306 | 48.52 | 71.61 | 020 | 020-f2-081606 | 3.31 | 2.23 |
| 005 | 005-f1-022707 | 20.84 | 43.84 | 021 | 021-f1-081606 | 58.98 | 45.42 |
| 006 | 006-f1-080806 | 43.10 | 61.31 | 022 | 022-f1-081706 | 23.16 | 58.46 |
| 006 | 006-f1-102306 | 14.13 | 22.85 | 023 | 023-f1-081706 | 44.15 | 92.46 |
| 006 | 006-f2-102306 | 4.48 | 3.00 | 023 | 023-f2-081706 | 3.59 | 2.40 |
| 006 | 006-f2d-102306 | 4.57 | 3.17 | 024 | 024-f1-081706 | 16.00 | 53.00 |
| 006 | 006-f1-022707 | 21.83 | 32.58 | 025 | 025-f1-082106 | 8.43 | 22.41 |
| 006 | 006-f2-022707 | 0.25 | 2.31 | 025 | 025-f1-022107 | 16.25 | 33.87 |
| 008 | 008-f1-080906 | 63.43 | 108.55 | 026 | 026-f1-082106 | 13.20 | 36.70 |
| 008 | 008-f2-080906 | 4.95 | 3.90 | 026 | 026-f2-082106 | 2.87 | 2.10 |
| 008 | 008-f1-030107 | 67.82 | 79.20 | 027 | 027-f1-082106 | 13.05 | 34.16 |
| 008 | 008-f2-030107 | 0.86 | 0.71 | 029 | 029-f1-082206 | 39.44 | 81.48 |
| 009 | 009-f1-080906 | 24.23 | 58.56 | 029 | 029-f2-082206 | 3.82 | 2.64 |
| 009 | 009-f1d-080906 | 24.59 | 56.90 | 030 | 030-f1-082206 | 25.27 | 56.66 |
| 010 | 010-f1-081006 | 50.67 | 135.52 | 030 | 030-f1d-082206 | 22.41 | 48.98 |
| 011 | 011-f1-081006 | 51.08 | 102.00 | 031 | 031-f1-082306 | 22.12 | 77.28 |
| 011 | 011-f2-081006 | 3.13 | 2.28 | 032 | 032-f1-082306 | 11.75 | 26.80 |
| 011 | 011-f1-030207 | 21.60 | 45.40 | 032 | 032-f2-082306 | 4.31 | 3.91 |
| 012 | 012-f1-081006 | NA | NA | 033 | 033-f1-082406 | 74.54 | 58.15 |
| 013 | 013-f1-081406 | 72.61 | 100.13 | 033 | 033-f1-082506 | 54.89 | 50.23 |
| 013 | 013-f1-102406 | 15.29 | 45.17 | 034 | 033-f1-082606 | 108.67 | 63.60 |
| 013 | 013-f2-102406 | 3.12 | 53.26 | 034 | 034-f1-082406 | 7.26 | 14.37 |
| 014 | 014-f1-081406 | 1.90 | 7.72 | 037 | 034-f2-082406 | 3.16 | 2.28 |
| 014 | 014-f2-081406 | 1.38 | 0.72 | 038 | 037-f1-090506 | 25.42 | 40.66 |
| 015 | 015-f1-081406 | 2.52 | 10.49 | 038 | 038-f1-090506 | 52.85 | 105.76 |
| 016 | 016-f1-081506 | 4.51 | 10.07 | 038 | 038-f2-090506 | 2.30 | 2.10 |
| 017 | 017-f1-081506 | 2.90 | 7.80 | 039 | 038-f1-012407 | 11.27 | 27.09 |
| 017 | 017-f2-081506 | 2.32 | 1.04 | 039 | 039-f1-090506 | 45.97 | 42.43 |
| 017 | 017-f1-022107 | 6.29 | 18.55 | 040 | 039-f1-012407 | 32.25 | 21.59 |
| | | | | 040 | 040-f1-090606 | 22.00 | 47.44 |

Formaldehyde and acetaldehyde, sample IDs and concentrations.

| Home ID | Sample ID | Acetaldehyde ($\mu g/m^3$) | Formaldehyde ($\mu g/m^3$) | Home ID | Sample ID | Acetaldehyde ($\mu g/m^3$) | Formaldehyde ($\mu g/m^3$) |
|---|---|---|---|---|---|---|---|
| 041 | 041-f1-090606 | 31.30 | 35.94 | 059 | 059-f1-012907 | 12.67 | 17.67 |
| 041 | 041-f2-090606 | 4.82 | 4.08 | 061 | 061-f1-091806 | 59.51 | 33.48 |
| 041 | 041-f1-012507 | 14.62 | 13.65 | 062 | 062-f1-091806 | 18.85 | 34.98 |
| 041 | 041-f2-012507 | 1.73 | 1.20 | 062 | 062-f2-091806 | 4.02 | 3.46 |
| 041 | 041-f1-012607 | 18.49 | 16.68 | 062 | 062-f2d-091806 | 4.17 | 3.50 |
| 041 | 041-f1-012707 | 22.95 | 22.54 | 062 | 062-f1-012507 | 9.92 | 15.46 |
| 042 | 042-f1-090606 | 30.08 | 58.71 | 064 | 064-f1-091906 | 14.05 | 48.84 |
| 043 | 043-f1-090706 | 22.32 | 65.52 | 064 | 064-f1d-091906 | 13.66 | 46.88 |
| 044 | 044-f1-090706 | 10.99 | 20.07 | 065 | 065-f1-091906 | 11.67 | 25.21 |
| 044 | 044-f2-090706 | 4.55 | 3.22 | 065 | 065-f2-091906 | 2.59 | 1.25 |
| 044 | 044-f1-012607 | 15.04 | 18.96 | 066 | 066-f1-091906 | 12.17 | 20.67 |
| 044 | 044-f1d-012607 | 14.07 | 17.15 | 067 | 067-f1-092006 | 8.72 | 12.41 |
| 045 | 045-f1-090706 | 33.42 | 125.72 | 068 | 068-f1-092006 | 14.54 | 15.99 |
| 045 | 045-f1d-090706 | 39.18 | 143.70 | 068 | 068-f2-092006 | 2.46 | 2.05 |
| 045 | 045-f1-012307 | NA | NA | 069 | 069-f1-092006 | 55.12 | 63.58 |
| 046 | 046-f1-090806 | 28.59 | 105.13 | 070 | 070-f1-092106 | 7.86 | 25.33 |
| 047 | 047-f1-090806 | 34.70 | 96.48 | 071 | 071-f1-092106 | 7.28 | 24.46 |
| 047 | 047-f2-090806 | 3.50 | 2.89 | 071 | 071-f2-092106 | 2.77 | 8.04 |
| 048 | 048-f1-090806 | 20.96 | 62.48 | 072 | 072-f1-092106 | 8.60 | 16.73 |
| 049 | 049-f1-091206 | 36.26 | 77.44 | 073 | 073-f1-012307 | 17.86 | 15.22 |
| 049 | 049-f1-013007 | 14.18 | 31.17 | 073 | 073-f2-012307 | 0.78 | 0.34 |
| 049 | 049-f2-013007 | 1.16 | 1.11 | 074 | 074-f1-012307 | 15.25 | 17.21 |
| 050 | 050-f1-091206 | 4.59 | 21.55 | 075 | 075-f1-012407 | 19.64 | 30.94 |
| 050 | 050-f2-091206 | 1.71 | 1.00 | 075 | 075-f2-012407 | 1.22 | 0.61 |
| 050 | 050-f1-013007 | 30.83 | 38.90 | 076 | 076-f1-012507 | 17.55 | 17.87 |
| 053 | 053-f1-091306 | 3.59 | 13.40 | 077 | 077-f1-012607 | 13.44 | 30.68 |
| 053 | 053-f2-091306 | 0.16 | 1.01 | 077 | 077-f2-012607 | 1.21 | 1.75 |
| 054 | 054-f1-091306 | 6.76 | 29.97 | 078 | 078-f1-012907 | 19.56 | 23.21 |
| 054 | 054-f1d-091306 | 4.92 | 24.32 | 078 | 078-f1d-012907 | 19.45 | 22.54 |
| 055 | 055-f1-091406 | 4.40 | 17.94 | 079 | 079-f1-012907 | NA | NA |
| 056 | 056-f1-091406 | 7.59 | 25.72 | 080 | 080-f1-013007 | 22.38 | 45.98 |
| 056 | 056-f2-091406 | 1.00 | 1.68 | 081 | 081-f1-013007 | 27.81 | 30.05 |
| 058 | 058-f1-091506 | 10.08 | 34.62 | 081 | 081-f2-013107 | 0.30 | 0.30 |
| 058 | 058-f1-013107 | 33.75 | 35.90 | 083 | 083-f1-020107 | 25.43 | 33.99 |
| 059 | 059-f1-091506 | 4.02 | 10.68 | 083 | 083-f1d-020107 | 18.24 | 25.24 |
| 059 | 059-f2-091506 | 0.68 | 3.14 | 084 | 084-f1-020107 | 12.44 | 39.56 |
| 059 | 059-f1-091606 | 5.81 | 14.30 | 084 | 084-f2-020107 | NA | NA |
| 059 | 059-f1-091706 | 6.70 | 13.53 | 085 | 085-f1-020107 | 16.80 | 34.11 |

Formaldehyde and acetaldehyde, sample IDs and concentrations.

| Home ID | Sample ID | Acetaldehyde ($\mu g/m^3$) | Formaldehyde ($\mu g/m^3$) | Home ID | Sample ID | Acetaldehyde ($\mu g/m^3$) | Formaldehyde ($\mu g/m^3$) |
|---|---|---|---|---|---|---|---|
| 086 | 086-f1-020507 | 27.17 | 47.52 | 112 | 112-f1-030507 | 15.20 | 38.72 |
| 086 | 086-f1d-020507 | NA | NA | 112 | 112-f2-030507 | 2.29 | 1.58 |
| 087 | 087-f1-020507 | 12.69 | 19.96 | 113 | 113-f1-030507 | 36.29 | 40.28 |
| 087 | 087-f2-020507 | 3.67 | 3.02 | 114 | 114-f1-030607 | 96.70 | 59.61 |
| 088 | 088-f1-020507 | 13.79 | 31.80 | 115 | 115-f1-030607 | 49.91 | 45.72 |
| 089 | 089-f1-020607 | 5.78 | 12.84 | 115 | 115-f2-030607 | 2.16 | 2.02 |
| 090 | 090-f1-020607 | 14.73 | 18.25 | 116 | 116-f1-030607 | 37.72 | 44.65 |
| 090 | 090-f2-020607 | 2.78 | 2.43 | 116 | 116-f1d-030607 | 37.07 | 45.05 |
| 091 | 091-f1-020607 | 15.46 | 40.65 | 117 | 117-f1-030707 | 33.46 | 71.18 |
| 092 | 092-f1-020707 | 31.04 | 39.51 | 118 | 118-f1-030707 | 43.76 | 65.56 |
| 092 | 092-f2-020707 | 3.41 | 2.88 | 118 | 118-f2-030707 | 0.60 | 1.23 |
| 092 | 092-f2d-020707 | 4.03 | 3.72 | 119 | 119-f1-030707 | 53.27 | 56.21 |
| 093 | 093-f1-020707 | 13.84 | 36.83 | 120 | 120-f1-030807 | 38.62 | 118.67 |
| 093 | 093-f1d-020707 | 9.49 | 25.98 | 121 | 121-f1-030807 | 28.80 | 34.63 |
| 094 | 094-f1-020807 | 21.39 | 28.48 | 121 | 121-f2-030807 | 0.35 | 2.46 |
| 095 | 095-f1-020807 | 16.94 | 28.54 | 121 | 121-f2d-030807 | 0.57 | 2.94 |
| 095 | 095-f2-020807 | 2.78 | 1.96 | 017 | 017-AA-022107 | 1.62 | 1.95 |
| 096 | 096-f1-020807 | 58.75 | 34.10 | 017 | 017-FAA-081706 | 7.58 | 9.18 |
| 097 | 097-f1-022007 | 11.62 | 48.55 | 017 | 017-FRA-081706 | 6.66 | 8.57 |
| 098 | 098-f1-022007 | 36.85 | 31.55 | 017 | 017-FSA-081506 | 7.70 | 10.20 |
| 098 | 098-f2-022007 | 0.69 | 2.87 | 017 | 017-RA-022107 | 5.90 | 15.26 |
| 099 | 099-f1-022207 | 56.53 | 85.97 | 017 | 017-SA-022107 | 5.38 | 13.65 |
| 099 | 099-f2-022207 | 1.83 | 3.06 | 033 | 033-FAA-082406 | NA | NA |
| 099 | 099-f1-022307 | 85.95 | 94.50 | 033 | 033-FRA-082406 | NA | NA |
| 099 | 099-f1-022407 | 57.25 | 86.43 | 033 | 033-FSA-082406 | NA | NA |
| 101 | 101-f1-022207 | 25.23 | 57.81 | 120 | 120-AA-030807 | 10.42 | 4.65 |
| 102 | 102-f1-022307 | 45.26 | 75.56 | 120 | 120-RA-030807 | 74.05 | 22.76 |
| 104 | 104-f1-022307 | 17.06 | 35.01 | 120 | 120-SA1-030807 | 69.98 | 20.90 |
| 104 | 104-f2-022307 | 2.18 | 1.68 | 120 | 120-SA2-030807 | 65.75 | 21.36 |
| 105 | 105-f1-022707 | 89.07 | 28.36 | | | | |
| 106 | 106-f1-022807 | 28.49 | 69.85 | | | | |
| 107 | 107-f1-022807 | 27.06 | 38.11 | | | | |
| 107 | 107-f2-022807 | 1.22 | 0.70 | | | | |
| 107 | 107-f2d-022807 | 1.50 | 1.19 | | | | |
| 108 | 108-f1-022807 | 19.81 | 37.92 | | | | |
| 109 | 109-f1-030207 | 101.48 | 85.71 | | | | |
| 110 | 110-f1-030207 | 15.42 | 70.73 | | | | |
| 110 | 110-f2-030207 | 1.37 | 3.21 | | | | |

Nitrogen dioxide sample IDs and concentrations.

| Home ID | Sample ID | Concentration (μg/m$^3$) | Home ID | Sample ID | Concentration (μg/m$^3$) |
|---|---|---|---|---|---|
| 002 | 002-N1-030107 | 5.97 | 106 | 106-N1-022807 | 6.07 |
| 004 | 004-N1-030107 | 9.41 | 107 | 107-N1-022807 | 5.66 |
| 005 | 005-N1-022707 | 5.65 | 107 | 107-N2-022807 | 5.74 |
| 006 | 006-N1-022707 | 5.57 | 107 | 107-N2D-022807 | 5.96 |
| 006 | 006-N2-022707 | 5.49 | 108 | 108-N1-022807 | 5.55 |
| 008 | 008-N1-030107 | 10.39 | 109 | 109-N1-030207 | 5.48 |
| 008 | 008-N2-030107 | 6.2 | 110 | 110-N1-030207 | 9.27 |
| 011 | 011-N1-030207 | 5.29 | 110 | 110-N2-030207 | 6.09 |
| 017 | 017-N1-022107 | 6.09 | 112 | 112-N1-030507 | 22.95 |
| 017 | 017-N2-022107 | 6.32 | 112 | 112-N2-030507 | 5.59 |
| 018 | 018-N1-022107 | 12.74 | 113 | 113-N1-030507 | 9.28 |
| 019 | 019-N1-022007 | 5.37 | 114 | 114-N1-030607 | 5.71 |
| 019 | 019-N1D-022007 | 5.55 | 115 | 115-N1-030607 | 6.43 |
| 025 | 025-N1-022107 | 5.63 | 115 | 115-N2-030607 | 5.66 |
| 097 | 097-N1-022007 | 19.56 | 116 | 116-N1-030607 | 15.95 |
| 098 | 098-N1-022007 | 5.34 | 116 | 116-N1D-030607 | 15.61 |
| 098 | 098-N2-022007 | 5.70 | 120 | 120-N1-030807 | 22.05 |
| 099 | 099-N1-022407 | 6.13 | 121 | 121-N1-030807 | 20.50 |
| 099 | 099-N1-022307 | 5.24 | 121 | 121-N2-030807 | 5.87 |
| 099 | 099-N1-022207 | 49.72 | 121 | 121-N2D-030807 | 6.03 |
| 099 | 099-N2-022207 | 14.28 | | | |
| 101 | 101-N1-022207 | 5.93 | | | |
| 102 | 102-N1-022307 | 5.85 | | | |
| 104 | 104-N1-022307 | 26.34 | | | |
| 104 | 104-N2-022307 | 5.33 | | | |
| 105 | 105-N1-022707 | 5.70 | | | |

$PM_{2.5}$ particulate matter sample IDs and concentrations.

| Home ID | Sample ID | Concentration (μg/m$^3$) | Home ID | Sample ID | Concentration (μg/m$^3$) |
|---|---|---|---|---|---|
| 002 | 002-P1-030107 | 9.14 | 104 | 104-P1-022307 | 8.54 |
| 004 | 004-P1-030107 | 11.40 | 104 | 104-P2-022307 | 150.04 |
| 005 | 005-P1-022707 | 10.94 | 105 | 105-P1-022707 | 6.19 |
| 006 | 006-P1-022707 | 33.99 | 106 | 106-P1-022807 | 21.75 |
| 006 | 006-P2-022707 | 145.76 | 107 | 107-P1-022807 | 9.92 |
| 008 | 008-P1-030107 | 8.30 | 107 | 107-P2-022807 | 139.41 |
| 008 | 008-P2-030107 | 129.13 | 107 | 107-P2D-022807 | 9.38 |
| 011 | 011-P1-030207 | 3.79 | 108 | 108-P1-022807 | 11.88 |
| 017 | 017-P1-022107 | 5.88 | 109 | 109-P1-030207 | 7.87 |
| 017 | 017-P2-022107 | 126.59 | 110 | 110-P1-030207 | 5.82 |
| 018 | 018-P1-022107 | NA | 110 | 110-P2-030207 | 131.30 |
| 019 | 019-P1-022007 | 10.15 | 112 | 112-P1-030507 | 8.57 |
| 019 | 019-P1D-022007 | 6.76 | 112 | 112-P2-030507 | 143.15 |
| 025 | 025-P1-022107 | 6.06 | 113 | 113-P1-030507 | 8.69 |
| 097 | 097-P1-022007 | 32.35 | 114 | 114-P1-030607 | 6.06 |
| 098 | 098-P1-022007 | 13.53 | 115 | 115-P1-030607 | 29.88 |
| 098 | 098-P2-022007 | 140.46 | 115 | 115-P2-030607 | 141.39 |
| 099 | 099-P1-022407 | 6.72 | 116 | 116-P1-030607 | 35.51 |
| 099 | 099-P1-022307 | 17.09 | 116 | 116-P1D-030607 | 38.02 |
| 099 | 099-P1-022207 | 16.12 | 120 | 120-P1-030807 | 11.55 |
| 099 | 099-P2-022207 | 140.10 | 121 | 121-P1-030807 | 12.54 |
| 101 | 101-P1-022207 | 12.43 | 121 | 121-P2D-030807 | 10.52 |
| 102 | 102-P1-022307 | 15.81 | | | |

Carbon monoxide and carbon dioxide concentrations, and temperature and relative humidity sample IDs.

| Home ID | Sample Type | Date | 24 Hr $CO_2$ (ppm) | 24 Hr CO (ppm) | 24 Hr Temp (F) | 24 Hr RH (%) | Max 1 Hr CO (ppm) | Max 8 Hr CO (ppm) |
|---|---|---|---|---|---|---|---|---|
| 1 | CC1 | 8/7/06 | 764.55 | 0.14 | 76.83 | 50.51 | 2.33 | 0.42 |
| 2 | CC1 | 8/7/06 | 379.10 | 0.29 | 72.84 | 50.39 | 0.49 | 0.35 |
| 2 | CC2 | 8/7/06 | 298.85 | 1.70 | 68.97 | 62.19 | 3.42 | 2.71 |
| 2 | C1 | 3/1/07 | 745.15 | 0.58 | 65.90 | 44.41 | 1.17 | 0.82 |
| 3 | CC1 | 8/7/06 | 440.70 | 0.02 | 76.78 | 46.70 | 0.44 | 0.06 |
| 4 | CC1 | 8/8/06 | 504.45 | 0.45 | 75.48 | 51.57 | 2.24 | 0.96 |
| 4 | C1 | 3/1/07 | 1156.03 | 3.92 | 67.29 | 52.18 | 7.28 | 5.40 |
| 5 | CC1 | 8/8/06 | 795.82 | 1.62 | 74.58 | 54.86 | 2.02 | 1.79 |
| 5 | C1 | 10/23/06 | 1023.12 | 1.94 | 71.52 | 52.22 | 2.17 | 2.09 |
| 5 | CC2 | 8/8/06 | 349.59 | 0.73 | 82.72 | 45.81 | 1.86 | 1.50 |
| 5 | C1 | 2/27/07 | 664.99 | 0.00 | 67.25 | 43.16 | 0.02 | 0.00 |
| 6 | C2 | 2/27/07 | 319.94 | 2.77 | 44.93 | 80.60 | 3.77 | 3.66 |
| 6 | CC1 | 8/8/06 | 631.93 | 0.83 | 75.04 | 53.21 | 1.04 | 0.92 |
| 6 | C1 | 2/27/07 | 563.73 | 0.54 | 63.65 | 47.05 | 1.12 | 0.66 |
| 6 | C2D | 10/23/06 | 390.70 | 1.53 | 64.50 | 52.48 | 3.65 | 2.78 |
| 6 | C2 | 10/23/06 | 383.90 | 1.50 | 64.63 | 53.10 | 3.20 | 2.46 |
| 6 | C1 | 10/23/06 | 453.79 | 0.26 | 73.09 | 39.02 | 0.91 | 0.32 |
| 8 | C1 | 3/1/07 | 832.66 | 0.00 | 74.66 | 38.78 | 0.00 | 0.00 |
| 8 | C2 | 3/1/07 | 316.92 | 2.31 | 50.41 | 67.49 | 3.29 | 3.14 |
| 8 | CC1 | 8/9/06 | 863.53 | 2.32 | 81.67 | 50.90 | 6.75 | 2.61 |
| 8 | CC2 | 8/9/06 | 337.50 | 1.13 | 82.39 | 43.59 | 2.13 | 1.66 |
| 9 | CC1 | 8/9/06 | 614.29 | 1.72 | 78.88 | 46.46 | 3.22 | 2.01 |
| 9 | CC1D | 8/9/06 | 616.04 | 2.12 | 78.83 | 46.25 | 3.44 | 2.43 |
| 10 | CC1 | 8/10/06 | 753.49 | 0.61 | 78.35 | 49.73 | 1.04 | 0.91 |
| 11 | C1 | 3/2/07 | 431.74 | 0.20 | 62.71 | 49.08 | 0.40 | 0.32 |
| 11 | CC1 | 8/10/06 | 874.73 | 1.25 | 77.28 | 54.26 | 1.96 | 1.52 |
| 11 | CC2 | 8/10/06 | 343.22 | 0.31 | 82.84 | 36.08 | 1.50 | 0.73 |
| 12 | CC1 | 8/10/06 | 460.17 | 0.52 | 80.51 | 41.36 | 1.71 | 0.73 |
| 13 | CC1 | 8/14/06 | 1108.16 | 1.84 | 73.91 | 54.03 | 3.03 | 2.44 |
| 13 | C1 | 10/24/06 | 525.64 | 0.56 | 74.23 | 37.03 | 1.64 | 1.41 |
| 13 | C2 | 10/24/06 | 340.24 | 1.05 | 64.18 | 40.05 | 3.40 | 2.49 |
| 14 | CC2 | 8/14/06 | 318.39 | 1.39 | 67.59 | 68.42 | 2.39 | 2.13 |
| 14 | CC1 | 8/14/06 | 351.58 | 0.85 | 71.72 | 55.43 | 1.28 | 1.00 |
| 15 | CC1 | 8/14/06 | 334.20 | 0.42 | 73.26 | 52.78 | 0.62 | 0.53 |
| 16 | CC1 | 8/15/06 | 406.98 | 2.00 | 69.08 | 62.32 | 2.34 | 2.31 |
| 17 | CC1 | 8/15/06 | 386.85 | 0.79 | 73.82 | 54.11 | 1.35 | 1.15 |
| 17 | CC2 | 8/15/06 | 293.24 | 1.74 | 70.58 | 63.59 | 2.82 | 2.56 |
| 17 | C2 | 2/21/07 | 314.89 | 2.49 | 52.50 | 78.52 | 3.80 | 3.44 |
| 17 | C1 | 2/21/07 | 478.17 | 0.01 | 72.26 | 40.09 | 0.06 | 0.02 |
| 18 | CC1 | 8/15/06 | 430.06 | 0.01 | 76.27 | 47.89 | 0.13 | 0.02 |
| 18 | CC1D | 8/15/06 | 443.13 | 1.28 | 76.54 | 48.31 | 1.87 | 1.50 |
| 18 | C1 | 2/21/07 | 541.10 | 0.00 | 70.78 | 42.27 | 0.02 | 0.00 |
| 19 | CC1 | 8/16/06 | 392.10 | 1.08 | 71.93 | 46.91 | 1.99 | 1.49 |
| 19 | C1D | 2/20/07 | 572.85 | 1.14 | NA | NA | 2.71 | 1.84 |
| 19 | C1 | 2/20/07 | 564.84 | 1.22 | 67.08 | 44.87 | 1.79 | 1.54 |
| 19 | C1 | 10/24/06 | 463.54 | 0.46 | 70.59 | 42.29 | 0.78 | 0.63 |
| 20 | CC1 | 8/16/06 | 459.73 | 0.48 | 79.38 | 43.20 | 0.84 | 0.66 |
| 20 | CC2 | 8/16/06 | 323.43 | 0.13 | 73.04 | 48.27 | 1.13 | 0.38 |
| 21 | CC1 | 8/16/06 | 639.20 | 0.92 | 76.55 | 50.27 | 2.02 | 1.09 |
| 22 | CC1 | 8/17/06 | 558.52 | 0.20 | 78.37 | 44.01 | 0.38 | 0.26 |
| 23 | CC1 | 8/17/06 | 720.85 | 0.01 | 76.62 | 48.19 | 0.04 | 0.01 |
| 23 | CC2 | 8/17/06 | 299.56 | 0.35 | 78.77 | 46.32 | 1.00 | 0.70 |

Carbon monoxide and carbon dioxide concentrations, and temperature and relative humidity sample IDs.

| Home ID | Sample Type | Date | 24 Hr $CO_2$ (ppm) | 24 Hr CO (ppm) | 24 Hr Temp (F) | 24 Hr RH (%) | Max 1 Hr CO (ppm) | Max 8 Hr CO (ppm) |
|---|---|---|---|---|---|---|---|---|
| 24 | CC1 | 8/17/06 | 395.57 | 0.32 | 77.41 | 46.19 | 0.62 | 0.45 |
| 25 | C1 | 2/21/07 | 501.90 | 0.13 | 68.87 | 44.39 | 0.76 | 0.22 |
| 25 | CC1 | 8/21/06 | 393.03 | 1.29 | 73.98 | 52.60 | 1.62 | 1.52 |
| 26 | CC2 | 8/21/06 | 314.00 | 0.36 | 74.48 | 56.62 | 1.26 | 0.75 |
| 26 | CC1 | 8/21/06 | 440.28 | 0.32 | 74.36 | 51.12 | 0.64 | 0.57 |
| 27 | CC1 | 8/21/06 | 393.72 | 0.18 | 77.78 | 46.74 | 0.34 | 0.24 |
| 29 | CC2 | 8/22/06 | 337.75 | 0.01 | 79.35 | 38.83 | 0.21 | 0.03 |
| 29 | CC1 | 8/22/06 | 555.82 | 1.62 | 78.08 | 49.25 | 2.07 | 2.02 |
| 30 | CC1D | 8/22/06 | 613.08 | 1.44 | 74.09 | 42.60 | 2.49 | 1.99 |
| 30 | CC1 | 8/22/06 | 595.67 | 0.73 | 73.72 | 42.68 | 2.29 | 1.53 |
| 31 | CC1 | 8/23/06 | 541.44 | 1.37 | 80.87 | 38.91 | 2.17 | 1.47 |
| 32 | CC2 | 8/23/06 | 359.53 | 0.55 | 75.63 | 45.33 | 2.14 | 1.43 |
| 32 | CC1 | 8/23/06 | 468.78 | 0.00 | 80.89 | 37.62 | 0.00 | 0.00 |
| 33 | CC1 | 8/25/06 | 548.44 | 0.96 | 74.71 | 48.12 | 1.36 | 1.11 |
| 33 | CC1 | 8/24/06 | 616.43 | 1.16 | 75.02 | 46.05 | 1.49 | 1.34 |
| 33 | CC1 | 8/26/06 | 852.46 | 1.19 | 74.61 | 48.09 | 1.61 | 1.45 |
| 34 | CC1 | 8/24/06 | 452.96 | 0.73 | 67.56 | 63.51 | 1.69 | 1.16 |
| 34 | CC2 | 8/24/06 | 286.97 | 1.47 | 71.09 | 57.82 | 3.08 | 2.40 |
| 37 | CC1 | 9/5/06 | 577.59 | 1.77 | 76.80 | 44.87 | 2.29 | 2.06 |
| 38 | C1 | 1/24/07 | 487.08 | 0.03 | 72.39 | 19.48 | 0.08 | 0.04 |
| 38 | CC1 | 9/5/06 | 511.22 | 0.04 | 76.40 | 44.63 | 0.32 | 0.12 |
| 38 | CC2 | 9/5/06 | 304.35 | -0.31 | 84.37 | 35.85 | 2.14 | 1.43 |
| 39 | C1 | 1/24/07 | 838.14 | 1.57 | 67.47 | 31.85 | 3.13 | 2.01 |
| 39 | CC1 | 9/5/06 | 723.77 | 2.56 | 77.56 | 42.58 | 3.02 | 2.97 |
| 40 | CC1 | 9/6/06 | 575.58 | 0.64 | 82.80 | 37.61 | 1.23 | 0.98 |
| 41 | C1 | 1/25/07 | 641.70 | 0.82 | 67.98 | 25.50 | 1.12 | 0.85 |
| 41 | C1 | 1/26/07 | 721.65 | 1.00 | 66.45 | 28.14 | 1.57 | 1.04 |
| 41 | C1 | 1/27/07 | 773.38 | 1.08 | 66.15 | 32.92 | 1.81 | 1.27 |
| 41 | C2 | 1/25/07 | 258.40 | 0.40 | 52.84 | 33.62 | 1.33 | 0.92 |
| 41 | CC2 | 9/6/06 | 301.08 | -0.05 | 81.57 | 36.57 | 2.10 | 1.28 |
| 41 | CC1 | 9/6/06 | 750.76 | 0.25 | 75.47 | 39.75 | 0.59 | 0.47 |
| 42 | CC1 | 9/6/06 | 593.41 | 0.29 | 79.25 | 39.21 | 0.58 | 0.34 |
| 43 | CC1 | 9/7/06 | 402.85 | 0.43 | 74.76 | 44.13 | 1.08 | 0.92 |
| 44 | CC1 | 9/7/06 | 513.74 | 0.21 | 78.19 | 45.75 | 0.39 | 0.28 |
| 44 | CC2 | 9/7/06 | 317.53 | 2.32 | 71.26 | 67.04 | 3.65 | 3.45 |
| 44 | C1D | 1/26/07 | 801.25 | 0.75 | 67.20 | 28.20 | 1.88 | 1.51 |
| 44 | C1 | 1/26/07 | 785.67 | 1.55 | 67.25 | 27.96 | 2.09 | 1.96 |
| 45 | C1 | 1/23/07 | 599.72 | 0.12 | 70.44 | 21.67 | 1.76 | 0.36 |
| 45 | CC1 | 9/7/06 | 773.83 | 1.63 | 80.33 | 41.50 | 2.45 | 2.26 |
| 45 | CC1D | 9/7/06 | 789.00 | 0.15 | 81.06 | 40.85 | 1.13 | 0.45 |
| 46 | CC1 | 9/8/06 | 522.90 | 0.28 | 78.68 | 40.95 | 0.62 | 0.56 |
| 47 | CC1 | 9/8/06 | 549.76 | 1.24 | 76.12 | 43.98 | 2.29 | 1.58 |
| 47 | CC2 | 9/8/06 | 342.06 | 0.96 | 70.28 | 66.67 | 1.80 | 1.62 |
| 48 | CC1 | 9/8/06 | 515.75 | 0.48 | 78.51 | 44.00 | 0.95 | 0.65 |
| 49 | C2 | 1/30/07 | 320.36 | 3.57 | 50.98 | 93.26 | 4.39 | 4.21 |
| 49 | C1 | 1/30/07 | 772.59 | 1.65 | 65.73 | 45.84 | 2.50 | 2.10 |
| 49 | CC1 | 9/12/06 | 720.86 | 0.24 | 75.62 | 79.80 | 0.77 | 0.54 |
| 50 | CC1 | 9/12/06 | 384.43 | 1.52 | 76.85 | 59.52 | 2.01 | 1.70 |
| 50 | CC2 | 9/12/06 | 348.35 | 1.21 | 72.71 | 72.82 | 2.28 | 1.90 |
| 50 | C1 | 1/30/07 | 817.48 | 0.34 | 69.88 | 42.21 | 1.19 | 0.45 |
| 53 | CC1 | 9/13/06 | 365.48 | 0.93 | 74.58 | 60.97 | 1.26 | 1.03 |
| 53 | CC2 | 9/13/06 | 297.72 | 1.13 | 69.49 | 72.21 | 1.81 | 1.62 |
| 54 | CC1 | 9/13/06 | 404.58 | 0.80 | 74.87 | 60.98 | 1.12 | 0.98 |

Carbon monoxide and carbon dioxide concentrations, and temperature and relative humidity sample IDs.

| Home ID | Sample Type | Date | 24 Hr $CO_2$ (ppm) | 24 Hr CO (ppm) | 24 Hr Temp (F) | 24 Hr RH (%) | Max 1 Hr CO (ppm) | Max 8 Hr CO (ppm) |
|---|---|---|---|---|---|---|---|---|
| 54 | CC1D | 9/13/06 | 397.28 | 1.48 | 74.55 | 60.72 | 1.74 | 1.64 |
| 55 | CC1 | 9/14/06 | 436.81 | 1.08 | 75.31 | 56.79 | 1.66 | 1.37 |
| 56 | CC1 | 9/14/06 | 416.94 | 0.04 | 73.68 | 59.09 | 0.24 | 0.10 |
| 56 | CC2 | 9/14/06 | 339.39 | 1.53 | 67.83 | 69.47 | 1.78 | 1.68 |
| 58 | CC1 | 9/15/06 | 443.37 | 1.53 | 74.60 | 55.69 | 1.72 | 1.58 |
| 58 | C1 | 1/31/07 | 541.70 | 1.44 | 70.28 | 42.69 | 1.68 | 1.52 |
| 59 | CC1 | 9/17/06 | 353.03 | NA | 72.05 | 46.04 | NA | NA |
| 59 | C1 | 1/29/07 | 390.41 | 1.75 | 62.07 | 55.93 | 2.85 | 2.12 |
| 59 | CC2 | 9/15/06 | 323.01 | 2.33 | 63.81 | 76.72 | 3.47 | 3.09 |
| 59 | CC1 | 9/15/06 | 368.43 | 1.43 | 69.49 | 61.23 | 1.62 | 1.58 |
| 59 | C2 | 1/29/07 | 330.39 | 3.44 | 51.70 | 94.05 | 3.88 | 3.67 |
| 59 | CC1 | 9/16/06 | 376.15 | 0.91 | 70.21 | 63.67 | 1.61 | 1.41 |
| 61 | CC1 | 9/18/06 | 703.31 | 1.00 | 75.51 | 40.94 | 1.45 | 1.30 |
| 62 | C1 | 1/25/07 | 586.68 | 0.06 | 69.20 | 24.26 | 0.31 | 0.09 |
| 62 | CC2D | 9/18/06 | 307.89 | 0.02 | 72.55 | 30.74 | 0.47 | 0.07 |
| 62 | CC2 | 9/18/06 | 302.07 | 0.02 | 72.41 | 31.66 | 0.35 | 0.06 |
| 62 | CC1 | 9/18/06 | 573.18 | 0.12 | 77.21 | 36.16 | 0.23 | 0.15 |
| 64 | CC1D | 9/19/06 | 486.16 | 0.40 | 77.35 | 28.29 | 1.11 | 0.64 |
| 64 | CC1 | 9/19/06 | 475.71 | 0.02 | 77.18 | 28.60 | 0.20 | 0.06 |
| 65 | CC2 | 9/19/06 | 322.59 | 0.36 | 69.66 | 37.47 | 1.74 | 0.99 |
| 65 | CC1 | 9/19/06 | 545.48 | 0.83 | 75.65 | 33.18 | 2.00 | 1.17 |
| 66 | CC1 | 9/19/06 | 451.87 | 0.01 | 73.67 | 39.13 | 0.07 | 0.04 |
| 67 | CC1 | 9/20/06 | 484.10 | 0.52 | 71.86 | 27.60 | 1.63 | 0.84 |
| 68 | CC1 | 9/20/06 | 452.88 | 0.24 | 74.06 | 27.58 | 0.67 | 0.42 |
| 68 | CC2 | 9/20/06 | 327.15 | 0.07 | 66.97 | 39.20 | 0.61 | 0.20 |
| 69 | CC1 | 9/20/06 | 892.81 | 0.83 | 78.77 | 30.06 | 2.08 | 1.26 |
| 70 | CC1 | 9/21/06 | 445.14 | 0.70 | 75.73 | 36.83 | 1.35 | 1.16 |
| 71 | CC2 | 9/21/06 | 322.50 | 1.89 | 68.97 | 43.85 | 2.81 | 2.10 |
| 71 | CC1 | 9/21/06 | 430.25 | 0.00 | 76.26 | 29.67 | 0.03 | 0.00 |
| 72 | CC1 | 9/21/06 | 484.27 | 0.01 | 77.47 | 31.40 | 0.30 | 0.04 |
| 73 | C1 | 1/23/07 | 555.53 | 0.00 | 70.57 | 22.65 | 0.04 | 0.01 |
| 73 | C2 | 1/23/07 | 315.33 | 0.35 | 57.69 | 25.10 | 1.35 | 0.72 |
| 74 | C1 | 1/23/07 | 706.92 | 0.22 | 68.69 | 25.31 | 0.95 | 0.41 |
| 75 | C1 | 1/24/07 | 617.95 | 0.01 | 71.93 | 22.79 | 0.09 | 0.03 |
| 75 | C2 | 1/24/07 | 280.50 | 0.00 | 56.80 | 25.49 | 0.01 | 0.00 |
| 76 | C1 | 1/25/07 | 563.85 | 0.06 | 64.65 | 24.39 | 0.12 | 0.08 |
| 77 | C1 | 1/26/07 | 557.28 | 0.08 | NA | NA | 0.19 | 0.12 |
| 77 | C2 | 1/26/07 | 333.75 | 3.03 | 50.17 | 76.02 | 3.86 | 3.57 |
| 78 | C1 | 1/29/07 | 561.37 | 1.67 | 69.23 | 41.39 | 2.60 | 1.80 |
| 78 | C1D | 1/29/07 | 582.28 | 0.23 | 68.87 | 42.05 | 1.45 | 0.39 |
| 79 | C1 | 1/29/07 | 523.34 | 0.92 | 64.56 | 47.77 | 2.29 | 1.23 |
| 80 | C1 | 1/30/07 | 927.60 | 1.20 | 68.06 | 45.18 | 2.82 | 2.00 |
| 81 | C2 | 1/31/07 | 312.89 | 2.11 | 51.15 | 82.63 | 2.76 | 2.57 |
| 81 | C1 | 1/31/07 | 581.16 | NA | 68.78 | 44.68 | NA | NA |
| 83 | C1 | 2/1/07 | 616.15 | 0.80 | 65.09 | 48.40 | 2.09 | 0.94 |
| 83 | C1D | 2/1/07 | 572.75 | 1.08 | 64.73 | 49.04 | 3.26 | 1.28 |
| 84 | C1 | 2/1/07 | 557.29 | 1.34 | NA | NA | 2.36 | 1.61 |
| 84 | C2 | 2/1/07 | 336.98 | 3.40 | 52.09 | 75.16 | 4.89 | 4.40 |
| 85 | C1 | 2/1/07 | 660.90 | 1.60 | 65.72 | 48.95 | 2.85 | 1.90 |
| 86 | C1D | 2/5/07 | 912.76 | 0.17 | 72.49 | 32.13 | 1.26 | 0.32 |
| 86 | C1 | 2/5/07 | 911.02 | 1.13 | NA | NA | 3.05 | 1.45 |
| 87 | C1 | 2/5/07 | 657.18 | 0.71 | 72.51 | 28.14 | 1.94 | 0.85 |
| 87 | C2 | 2/5/07 | 354.01 | 0.14 | 66.82 | 28.67 | 1.26 | 0.28 |

Carbon monoxide and carbon dioxide concentrations, and temperature and relative humidity sample IDs.

| Home ID | Sample Type | Date | 24 Hr $CO_2$ (ppm) | 24 Hr CO (ppm) | 24 Hr Temp (F) | 24 Hr RH (%) | Max 1 Hr CO (ppm) | Max 8 Hr CO (ppm) |
|---|---|---|---|---|---|---|---|---|
| 88 | C1 | 2/5/07 | 509.37 | 1.78 | 69.63 | 33.18 | 1.90 | 1.83 |
| 92 | C1 | 2/7/07 | 1027.85 | 1.64 | 70.40 | 43.12 | 2.58 | 2.13 |
| 93 | C1 | 2/7/07 | 561.80 | 1.10 | 64.78 | 37.50 | 1.41 | 1.33 |
| 93 | C1D | 2/7/07 | 547.92 | 0.24 | 64.30 | 37.88 | 0.40 | 0.35 |
| 94 | C1 | 2/8/07 | 930.72 | 2.41 | 70.27 | 29.80 | 4.69 | 3.70 |
| 95 | C1 | 2/8/07 | 751.66 | 0.41 | 67.86 | 34.48 | 0.83 | 0.44 |
| 95 | C2 | 2/8/07 | 344.37 | 1.91 | 57.51 | 36.99 | 3.03 | 2.62 |
| 96 | C1 | 2/8/07 | 632.60 | 1.43 | 66.95 | 31.50 | 2.77 | 2.48 |
| 97 | C1 | 2/20/07 | 552.90 | 0.17 | 74.29 | 35.34 | 1.21 | 0.27 |
| 98 | C1 | 2/20/07 | 875.54 | 1.92 | 64.18 | 51.69 | 2.33 | 2.15 |
| 98 | C2 | 2/20/07 | 335.11 | 1.51 | 52.15 | 73.39 | 2.39 | 2.21 |
| 99 | C1 | 2/22/07 | 754.63 | 1.12 | 67.80 | 47.90 | 2.23 | 1.72 |
| 99 | C1 | 2/23/07 | 813.78 | 1.35 | 67.91 | 46.72 | 1.95 | 1.81 |
| 99 | C1 | 2/24/07 | 715.09 | 1.91 | 67.43 | 46.83 | 2.13 | 1.99 |
| 99 | C2 | 2/22/07 | 315.92 | 2.41 | 45.20 | 82.06 | 3.52 | 3.07 |
| 102 | C1 | 2/23/07 | 1020.33 | 1.88 | 68.05 | 46.80 | 2.43 | 2.11 |
| 104 | C1 | 2/23/07 | 663.34 | 1.22 | 69.68 | 38.14 | 2.05 | 1.80 |
| 104 | C2 | 2/23/07 | 325.49 | 1.93 | 47.57 | 61.59 | 2.87 | 2.66 |
| 105 | C1 | 2/27/07 | 656.01 | 1.64 | 62.73 | 52.16 | 1.99 | 1.89 |
| 106 | C1 | 2/28/07 | 748.66 | 1.64 | 67.05 | 51.38 | 2.32 | 1.94 |
| 107 | C2 | 2/28/07 | 349.19 | 1.53 | 48.10 | 65.87 | 3.16 | 2.52 |
| 107 | C2D | 2/28/07 | 280.70 | 1.51 | NA | NA | 3.35 | 2.65 |
| 107 | C1 | 2/28/07 | 631.57 | 0.69 | 68.71 | 45.28 | 1.52 | 0.96 |
| 108 | C1 | 2/28/07 | 562.91 | 1.85 | 65.49 | 46.92 | 3.07 | 2.27 |
| 109 | C1 | 3/2/07 | 838.49 | 1.61 | 69.41 | 45.46 | 2.25 | 1.91 |
| 110 | C1 | 3/2/07 | 723.12 | 0.73 | 66.36 | 45.90 | 3.15 | 1.90 |
| 110 | C2 | 3/2/07 | 334.54 | 1.70 | 53.40 | 67.35 | 2.50 | 2.31 |
| 112 | C1 | 3/5/07 | 582.87 | 0.52 | 68.61 | 45.14 | 1.28 | 0.92 |
| 112 | C2 | 3/5/07 | 327.21 | 0.25 | 64.25 | 44.08 | 0.53 | 0.40 |
| 113 | C1 | 3/5/07 | 663.02 | 1.51 | 67.44 | 50.60 | 2.54 | 2.02 |
| 114 | C1 | 3/6/07 | 890.43 | NA | 67.51 | 54.03 | NA | NA |
| 115 | C2 | 3/6/07 | 367.05 | 1.05 | 58.49 | 57.92 | 1.82 | 1.62 |
| 115 | C1 | 3/6/07 | 1013.39 | 2.32 | 68.67 | 51.94 | 2.77 | 2.41 |
| 116 | C1 | 3/6/07 | 627.57 | 1.73 | 69.79 | 46.13 | 2.01 | 1.88 |
| 116 | C1D | 3/6/07 | 612.52 | 2.06 | 69.61 | 46.62 | 2.39 | 2.26 |
| 117 | C1 | 3/7/07 | 754.28 | 0.45 | NA | NA | 0.64 | 0.55 |
| 118 | C1 | 3/7/07 | 925.97 | 2.09 | 72.24 | 47.17 | 2.40 | 2.20 |
| 118 | C2 | 3/7/07 | 312.60 | 2.22 | 58.54 | 71.60 | 3.31 | 3.10 |
| 119 | C1 | 3/7/07 | 763.51 | 1.43 | 66.91 | 52.53 | 1.51 | 1.47 |
| 120 | C1 | 3/8/07 | 1084.66 | 1.30 | 74.46 | 47.17 | 1.98 | 1.46 |
| 121 | C2D | 3/8/07 | 316.99 | 2.40 | 54.63 | 69.15 | 3.11 | 2.88 |
| 121 | C1 | 3/8/07 | 438.56 | 1.14 | 67.18 | 51.35 | 2.43 | 1.62 |

Outdoor air exchange rate PFT measurements.

| Home ID | Test Day 24 hour Sample ID | Test Day ach | Test Day Duplicate Sample ID | Test Day Duplicate ach | Long Term 2 Week Sample ID | Long Term ach | Long Term Duplicate Sample ID | Long Term Duplicate ach |
|---|---|---|---|---|---|---|---|---|
| 001 | 001-T1-080706 | 0.25 | | | | | | |
| 002 | 002-T1-030107 | 0.21 | | | 002-T1L-030107 | 0.24 | | |
| 002 | 002-T1-080706 | 6.47 | | | 002-T1L-080706 | 1.37 | 002-T1LD-080706 | 1.39 |
| 003 | 003-T1-080706 | 0.71 | | | | | | |
| 004 | 004-T1-080806 | 0.45 | | | | | | |
| 004 | 004-T1-030107 | 0.13 | | | | | | |
| 005 | 005-T1-080806 | 0.17 | | | | | | |
| 005 | 005-T1-102306 | 0.15 | | | | | | |
| 005 | 005-T1-022707 | 0.27 | | | | | | |
| 006 | 006-T1-080806 | 0.16 | | | 006-T1L-080806 | 0.22 | | |
| 006 | 006-T1-022707 | 0.23 | | | | | | |
| 006 | 006-T1-102306 | 0.63 | | | | | | |
| 008 | 008-T1-080906 | 0.21 | | | | | | |
| 008 | 008-T1-030107 | 0.23 | | | | | | |
| 009 | 009-T1-080906 | 0.34 | 009-T1D-080906 | 0.33 | | | | |
| 010 | 010-T1-081006 | 0.10 | | | | | | |
| 011 | 011-T1-081006 | 0.11 | | | | | | |
| 011 | 011-T1-030207 | 0.09 | | | | | | |
| 012 | 012-T1-081006 | 0.58 | | | | | | |
| 013 | 013-T1-081406 | 0.16 | | | | | | |
| 013 | 013-T1-102406 | 0.81 | | | 013-T1L-102406 | 0.27 | | |
| 014 | 014-T1-081406 | 5.34 | | | 014-T1L-081406 | 1.51 | | |
| 015 | 015-T1-081406 | 5.19 | | | | | | |
| 016 | 016-T1-081506 | 1.43 | | | | | | |
| 017 | 017-T1-081506 | 4.28 | | | | | | |
| 017 | 017-T1-022107 | 0.66 | | | | | | |
| 018 | 018-T1-081506 | 1.25 | 018-T1D-081506 | 1.25 | | | | |
| 018 | 018-T1-022107 | 0.61 | | | | | | |
| 019 | 019-T1-022007 | 0.11 | 019-T1D-022007 | 0.10 | | | | |
| 019 | 019-T1-081606 | NA | | | | | | |

Outdoor air exchange rate PFT measurements.

| Home ID | Test Day 24 hour Sample ID | Test Day ach | Test Day Duplicate Sample ID | Test Day Duplicate ach | Long Term 2 Week Sample ID | Long Term ach | Long Term Duplicate Sample ID | Long Term Duplicate ach |
|---|---|---|---|---|---|---|---|---|
| 019 | 019-T1-102406 | 0.29 | | | | | | |
| 020 | 020-T1-081606 | 0.21 | | | | | | |
| 021 | 021-T1-081606 | 0.16 | | | | | | |
| 022 | 022-T1-081706 | 0.41 | | | | | | |
| 023 | 023-T1-081706 | 0.17 | | | | | | |
| 024 | 024-T1-081706 | 0.45 | | | 024-T1L-081706 | 0.27 | | |
| 025 | 025-T1-022107 | 0.35 | | | | | | |
| 025 | 025-T1-082106 | 0.95 | | | 025-T1L-082106 | 0.83 | | |
| 026 | 026-T1-082106 | 0.33 | | | | | | |
| 027 | 027-T1-082106 | 1.25 | | | | | | |
| 029 | 029-T1-082206 | 0.19 | | | 029-T1L-082206 | 0.24 | | |
| 030 | 030-T1-082206 | 0.30 | 030-T1D-082206 | 0.31 | | | | |
| 031 | 031-T1-082306 | 0.44 | | | 031-T1-082306 | 0.27 | | |
| 032 | 032-T1-082306 | 0.73 | | | | | | |
| 033 | 033-T1-082406 | 0.23 | | | | | | |
| 033 | 033-T1-082606 | 0.13 | | | | | | |
| 033 | 033-T1-082506 | 0.29 | | | | | | |
| 034 | 034-T1-082406 | 0.59 | | | | | | |
| 037 | 037-T1-090506 | 0.29 | | | | | | |
| 038 | 038-T1-090506 | 0.13 | | | 038-T1L-090506 | 0.16 | | |
| 038 | 038-T1-012307 | 0.27 | | | 038-T1L-012307 | 0.14 | | |
| 039 | 039-T1-012407 | 0.17 | | | | | | |
| 039 | 039-T1-090506 | 0.20 | | | | | | |
| 040 | 040-T1-090606 | 0.39 | | | | | | |
| 041 | 041-T1-090606 | 0.21 | | | 041-T1L-090606 | 0.17 | | |
| 041 | 041-T1-012507 | 0.18 | | | | | | |
| 041 | 041-T1-012607 | 0.19 | | | | | | |
| 041 | 041-T1-012707 | 0.20 | | | | | | |
| 042 | 042-T1-090606 | 0.21 | | | | | | |
| 043 | 043-T1-090706 | 0.38 | | | | | | |
| 044 | 044-T1-012607 | 0.22 | 044-T1D-012607 | 0.22 | 044-T1L-012607 | 0.21 | 044-T1LD-012607 | 0.20 |

Outdoor air exchange rate PFT measurements.

| Home ID | Test Day 24 hour Sample ID | Test Day ach | Test Day Duplicate Sample ID | Test Day Duplicate ach | Long Term 2 Week Sample ID | Long Term ach | Long Term Duplicate Sample ID | Long Term Duplicate ach |
|---|---|---|---|---|---|---|---|---|
| 044 | 044-T1-090706 | 0.86 | | | | | | |
| 045 | 045-T1-090706 | 0.19 | 045-T1D-090706 | 0.20 | | | | |
| 045 | 045-T1-012307 | 0.24 | | | | | | |
| 046 | 046-T1-090806 | 0.28 | | | | | | |
| 047 | 047-T1-090806 | 0.15 | | | | | | |
| 048 | 048-T1-090806 | 0.33 | | | | | | |
| 049 | 049-T1-091206 | 0.14 | | | | | | |
| 049 | 049-T1-013007 | 0.13 | | | | | | |
| 050 | 050-T1-091206 | 3.17 | | | 050-T1L-091206 | 0.47 | | |
| 050 | 050-T1-013007 | 0.17 | | | | | | |
| 053 | 053-T1-091306 | 0.35 | | | | | | |
| 054 | 054-T1-091306 | 0.41 | 054-T1D-091306 | 0.38 | | | | |
| 055 | 055-T1-091406 | 1.04 | | | | | | |
| 056 | 056-T1-091406 | 0.66 | | | | | | |
| 058 | 058-T1-013107 | 0.15 | | | | | | |
| 058 | 058-T1-091506 | 0.48 | | | | | | |
| 059 | 059-T1-091706 | 1.25 | | | | | | |
| 059 | 059-T1-091606 | 1.79 | | | | | | |
| 059 | 059-T1-091506 | 2.25 | | | 059-T1L-091506 | 2.30 | | |
| 059 | 059-T1-012907 | 0.59 | | | | | | |
| 061 | 061-T1-091806 | 0.18 | | | | | | |
| 062 | 062-T1-091806 | 0.32 | | | | | | |
| 062 | 062-T1-012507 | 0.45 | | | | | | |
| 064 | 064-T1-091906 | 0.33 | 064-T1D-091906 | 0.36 | 064-T1L-091906 | 0.26 | | |
| 065 | 065-T1-091906 | 0.51 | | | | | | |
| 066 | 066-T1-091906 | 0.46 | | | | | | |
| 067 | 067-T1-092006 | 0.85 | | | 067-T1L-092006 | 0.78 | | |
| 068 | 068-T1-092006 | 0.33 | | | | | | |
| 069 | 069-T1-092006 | 0.20 | | | | | | |
| 070 | 070-T1-092106 | 0.85 | | | | | | |
| 071 | 071-T1-092106 | 0.57 | | | | | | |

Outdoor air exchange rate PFT measurements.

| Home ID | Test Day 24 hour Sample ID | Test Day ach | Test Day Duplicate Sample ID | Test Day Duplicate ach | Long Term 2 Week Sample ID | Long Term ach | Long Term Duplicate Sample ID | Long Term Duplicate ach |
|---|---|---|---|---|---|---|---|---|
| 072 | 072-T1-092106 | 0.77 | | | | | | |
| 073 | 073-T1-012307 | 0.32 | | | | | | |
| 074 | 074-T1-012307 | 0.17 | | | | | | |
| 075 | 075-T1-012407 | 0.25 | | | | | | |
| 076 | 076-T1-012507 | 0.25 | | | | | | |
| 077 | 077-T1-012607 | 0.11 | | | | | | |
| 078 | 078-T1-012907 | 0.39 | 078-T1D-012907 | 0.40 | 078-T1L-012907 | 0.42 | 078-T1LD-012907 | 0.43 |
| 079 | 079-T1-012907 | 0.38 | | | | | | |
| 080 | 080-T1-013007 | 0.20 | | | | | | |
| 081 | 081-T1-013107 | 0.29 | | | | | | |
| 083 | 083-T1-020107 | 0.41 | 083-T1D-020107 | 0.40 | 083-T1L-020107 | 0.32 | 083-T1LD-020107 | 0.32 |
| 084 | 084-T1-020107 | 0.25 | | | | | | |
| 085 | 085-T1-020107 | 0.26 | | | | | | |
| 086 | 086-T1-020507 | 0.09 | 086-T1D-020507 | 0.09 | | | | |
| 087 | 087-T1-020507 | 0.32 | | | | | | |
| 088 | 088-T1-0250507 | 0.13 | | | | | | |
| 089 | 089-T1-020607 | 0.50 | | | | | | |
| 090 | 090-T1-020607 | 0.18 | | | 090-T1L-020607 | 0.12 | | |
| 091 | 091-T1-020607 | 0.20 | | | | | | |
| 092 | 092-T1-020707 | 0.25 | | | | | | |
| 093 | 093-T1-020807 | 0.14 | 093-T1D-020807 | 0.13 | | | | |
| 094 | 094-T1-020807 | 0.20 | | | | | | |
| 095 | 095-T1-020807 | 0.17 | | | 095-T1L-020807 | 0.16 | | |
| 096 | 096-T1-020807 | 0.12 | | | | | | |
| 097 | 097-T1-022007 | 0.64 | | | | | | |
| 098 | 098-T1-022007 | 0.20 | | | | | | |
| 099 | 099-T1-022307 | 0.17 | | | | | | |
| 099 | 099-T1-022207 | NA | | | 099-T1L-022207 | 0.15 | 099-T1LD-022207 | 0.14 |
| 099 | 099-T1-022407 | 0.16 | | | | | | |
| 101 | 101-T1-022207 | 0.26 | | | | | | |
| 102 | 102-T1-022307 | 0.11 | | | 102-T1L-022307 | 0.11 | | |
| 104 | 104-T1-022307 | 0.66 | | | | | | |
| 105 | 105-T1-022707 | 0.23 | | | 105-T1L-022707 | 0.23 | | |

Outdoor air exchange rate PFT measurements.

| Home ID | Test Day 24 hour Sample ID | Test Day ach | Test Day Duplicate Sample ID | Test Day Duplicate ach | Long Term 2 Week Sample ID | Long Term ach | Long Term Duplicate Sample ID | Long Term Duplicate ach |
|---|---|---|---|---|---|---|---|---|
| 106 | 106-T1-022807 | 0.33 | | | 106-T1L-022807 | 0.24 | | |
| 107 | 107-T1-022807 | 0.23 | | | | | | |
| 108 | 108-T1-022807 | 0.24 | | | | | | |
| 109 | 109-T1-030207 | 0.13 | | | | | | |
| 110 | 110-T1-030207 | 0.30 | | | | | | |
| 112 | 112-T1-030507 | 0.31 | | | | | | |
| 113 | 113-T1-030507 | 0.13 | | | | | | |
| 114 | 114-T1-030607 | 0.09 | | | | | | |
| 115 | 115-T1-030607 | 0.18 | | | | | | |
| 116 | 116-T1-030607 | 0.22 | 116-T1D-030607 | 0.16 | | | | |
| 117 | 117-T1-030707 | 0.11 | | | | | | |
| 118 | 118-T1-030707 | 0.19 | | | 118-T1L-030707 | 0.19 | | |
| 119 | 119-T1-030707 | 0.11 | | | | | | |
| 120 | 120-T1-030807 | 0.12 | | | 120-T1L-030807 | 0.23 | | |
| 121 | 121-T1-030807 | 0.18 | | | | | | |

# APPENDIX F

## Home and Mechanical Ventilation System Characteristics

Appendix Key

| Label | Description |
|---|---|
| ad | Automatic Damper |
| DOA | Ducted Outdoor Air Mechanical Outdoor Air Ventilation System |
| EC | Evaporative Cooler |
| fc | Fan Cycler |
| ELA | Effective Leakage Area @ 10 pascals |
| Fl | Floor |
| G | Garage |
| gd | Gravity Damper |
| H | Home |
| HRV | Heat Recovery Ventilator Mechanical Outdoor Air Ventilation System |
| md | Manual Damper |
| na | Not Applicable / Not Available |
| OA | Outdoor Air |
| Occ | Occupants |
| RAD | Forced Air Unit Return Air Damper Nighttime Cooling System |
| t-stat | Thermostat |
| WD | Window |
| WDF | Window Fan |
| WHF | Whole House Fan Nighttime Cooling System |

Home characteristics and air leakage data.

| Home ID | Date | Home Age | # Occ | Fl Area | Volume | WD Area/ Fl Area | $ACH_{50}$ | SLA | Home to OA ELA | Home to Garage ELA | Garage to OA ELA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 001 | 8/8/06 | 3.27 | 2 | 1742 | 16624 | 0.08 | 4.49 | 3.18 | 141.90 | 10.90 | 127.75 |
| 002 | 3/4/07 | 3.93 | 2 | 1813 | 17328 | 0.07 | 4.23 | 2.94 | 137.50 | 23.16 | 189.58 |
| 003 | 8/8/06 | 3.02 | 4 | 2244 | 19584 | 0.06 | 4.92 | 3.00 | 176.20 | 22.95 | 71.68 |
| 004 | 8/9/06 | 2.77 | 2 | 2005 | 19136 | 0.05 | 3.78 | 2.45 | 129.80 | 22.53 | 184.03 |
| 005 | 2/28/07 | 2.85 | 5 | 3147 | 28391 | 0.08 | 6.14 | 3.26 | 285.60 | 35.95 | 143.89 |
| 006 | 2/28/07 | 3.27 | 4 | 3806 | 35404 | 0.07 | 5.37 | 2.69 | 294.70 | 27.25 | 152.28 |
| 008 | 8/10/06 | 2.86 | 2 | 1283 | 10918 | 0.07 | 5.64 | 3.04 | 105.80 | 10.69 | 155.84 |
| 009 | 8/10/06 | 2.27 | 1 | 1283 | 10667 | 0.04 | 6.14 | 3.70 | 122.70 | 14.57 | 171.03 |
| 010 | 8/11/06 | 2.86 | 1 | 1887 | 18047 | 0.07 | 4.28 | 2.81 | 139.70 | 11.00 | 160.14 |
| 011 | 3/3/07 | 2.28 | 1 | 1616 | 13821 | 0.08 | 5.97 | NA | NA | NA | NA |
| 012 | 8/11/06 | 3.11 | 2 | 1894 | 18107 | 0.05 | 4.37 | 2.61 | 134.60 | 10.06 | 278.25 |
| 013 | 8/15/06 | 4.12 | 4 | 2241 | 19901 | 0.06 | 5.16 | 2.98 | 179.50 | 14.25 | 226.79 |
| 014 | 8/15/06 | 3.12 | 3 | 3403 | 31320 | 0.03 | 4.59 | 2.88 | 258.50 | 29.87 | 191.99 |
| 015 | 8/15/06 | 3.21 | 2 | 2883 | 27340 | 0.06 | 5.20 | 2.86 | 231.10 | 46.53 | 292.08 |
| 016 | 8/16/06 | 3.13 | 1 | 2273 | 21580 | 0.07 | 4.93 | 2.08 | 145.70 | 51.67 | 350.35 |
| 017 | 2/22/07 | 3.29 | 2 | 2038 | 19556 | 0.05 | 4.58 | 2.83 | 155.40 | 10.69 | 156.05 |
| 018 | 8/16/06 | 3.54 | 2 | 1718 | 16304 | 0.06 | 5.30 | 3.51 | 158.00 | 18.44 | 194.72 |
| 019 | 8/17/06 | 2.88 | 4 | 4205 | 38916 | 0.05 | 4.46 | 2.15 | 262.90 | 16.35 | 260.53 |
| 020 | 8/17/06 | 3.30 | 1 | 2152 | 20748 | 0.05 | 5.56 | 3.31 | 194.80 | 20.12 | 110.15 |
| 021 | 8/17/06 | 3.13 | 2 | 1968 | 19764 | 0.07 | 4.14 | 2.88 | 148.80 | 8.80 | 139.38 |
| 022 | 8/18/06 | 3.05 | 2 | 1659 | 14223 | 0.08 | 6.45 | 4.04 | 172.70 | 27.04 | 300.78 |
| 023 | 8/18/06 | 3.38 | 5 | 3321 | 33317 | 0.05 | 4.88 | 2.63 | 251.60 | 42.23 | 423.29 |
| 024 | 8/18/06 | 1.96 | 2 | 2851 | 27414 | 0.07 | 4.63 | 2.66 | 210.20 | 17.29 | 343.12 |
| 025 | 8/22/06 | 3.31 | 2 | 2531 | 24128 | 0.07 | 4.21 | 2.62 | 177.90 | 15.30 | 424.76 |
| 026 | 8/22/06 | 3.72 | 2 | 2439 | 23416 | 0.06 | 4.32 | 2.41 | 164.50 | 5.34 | 303.29 |
| 027 | 8/22/06 | 1.80 | 5 | 2197 | 16615 | 0.06 | 4.00 | 2.10 | 120.80 | 13.52 | 91.39 |
| 029 | 8/23/06 | 2.14 | 3 | 3119 | 28910 | 0.04 | 3.61 | 1.66 | 153.50 | 29.76 | 243.35 |
| 030 | 8/23/06 | 3.64 | 5 | 2311 | 20497 | 0.06 | 6.35 | 3.34 | 214.60 | 29.76 | 243.35 |
| 031 | 8/24/06 | 2.90 | 3 | 2719 | 23294 | 0.05 | 3.45 | 2.01 | 144.40 | 0.00 | 297.01 |
| 032 | 8/24/06 | 3.40 | 5 | 2374 | 22909 | 0.06 | 5.91 | 3.24 | 217.10 | 6.39 | 231.09 |
| 033 | 8/27/06 | 3.40 | 4 | 2214 | 21182 | 0.07 | 4.23 | 2.61 | 155.70 | 5.76 | 327.71 |

Home characteristics and air leakage data.

| Home ID | Date | Home Age | # Occ | Fl Area | Volume | WD Area/ Fl Area | $ACH_{50}$ | SLA | Home to OA ELA | Home to Garage ELA | Garage to OA ELA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 034 | 8/25/06 | 5.48 | 4 | 5064 | 55613 | 0.03 | 4.62 | 3.31 | 450.50 | 0.00 | 959.03 |
| 037 | 9/6/06 | 3.27 | 4 | 3413 | 31772 | 0.07 | 4.40 | 2.71 | 246.70 | 28.51 | 136.87 |
| 038 | 1/24/07 | 2.35 | 2 | 3413 | 31772 | 0.08 | 4.75 | 2.98 | 269.60 | 34.58 | 132.68 |
| 039 | 1/24/07 | 3.10 | 4 | 3413 | 31772 | 0.07 | 4.60 | 2.83 | 258.30 | 9.54 | 167.05 |
| 040 | 9/7/06 | 3.93 | 4 | 2858 | 22276 | 0.05 | 3.93 | 2.12 | 159.20 | 13.83 | 61.20 |
| 041 | 1/28/07 | 3.02 | 3 | 2147 | 17661 | 0.06 | 6.33 | 3.40 | 195.90 | 12.79 | 55.54 |
| 042 | 9/7/06 | 3.02 | 3 | 3108 | 25522 | 0.05 | 3.64 | 2.02 | 166.20 | 18.13 | 61.52 |
| 043 | 9/8/06 | 4.19 | 4 | 2838 | 26996 | 0.05 | NA | NA | NA | NA | NA |
| 044 | 9/8/06 | 2.77 | 5 | 2765 | 25606 | 0.06 | 5.74 | 3.69 | 267.60 | 9.64 | 106.79 |
| 045 | 9/8/06 | 2.85 | 4 | 2301 | 19970 | 0.06 | 6.19 | 3.47 | 215.00 | 7.13 | 124.92 |
| 046 | 9/8/06 | 2.69 | 3 | 3212 | 26836 | 0.06 | 5.27 | 2.92 | 250.20 | 10.58 | 117.80 |
| 047 | 9/8/06 | 3.02 | 2 | 2226 | 18290 | 0.06 | 4.77 | 2.96 | 167.60 | 26.62 | 53.03 |
| 048 | 9/9/06 | 3.02 | 3 | 2515 | 20920 | 0.07 | 4.22 | 2.53 | 164.70 | 39.61 | 80.38 |
| 049 | 1/31/07 | 3.28 | 4 | 2952 | 27489 | 0.06 | 3.84 | 2.40 | 188.00 | 11.32 | 38.15 |
| 050 | 9/13/06 | 4.20 | 6 | 3327 | 32043 | 0.07 | 4.02 | 2.33 | 214.10 | 1.05 | 62.25 |
| 053 | 9/14/06 | 4.95 | 6 | 3647 | 34210 | 0.07 | 3.85 | 2.18 | 219.80 | 15.41 | 55.02 |
| 054 | 9/14/06 | 4.04 | 4 | 3753 | 34414 | 0.07 | 5.32 | 3.20 | 321.60 | 23.89 | 112.66 |
| 055 | 9/15/06 | 4.38 | 5 | 2537 | 24865 | 0.08 | 5.25 | 3.06 | 213.10 | 14.04 | 140.43 |
| 056 | 9/15/06 | 3.79 | 3 | 3338 | 32662 | 0.09 | 5.13 | 2.71 | 259.90 | 21.27 | 90.02 |
| 058 | 2/1/07 | 4.21 | 3 | 3659 | 34641 | 0.06 | 3.23 | 1.39 | 155.60 | 17.82 | 47.37 |
| 059 | 9/18/06 | 4.30 | 5 | 3756 | 32829 | 0.07 | 8.38 | 4.82 | 484.10 | 20.54 | 122.72 |
| 061 | 9/19/06 | 3.30 | 3 | 2935 | 24579 | 0.05 | 4.72 | 2.71 | 209.60 | 15.51 | 69.80 |
| 062 | 9/19/06 | 3.30 | 4 | 2790 | 22909 | 0.06 | 3.87 | 2.37 | 169.10 | 14.78 | 49.78 |
| 064 | 9/20/06 | 3.97 | 3 | 3144 | 28888 | 0.06 | 4.69 | 2.70 | 231.30 | 17.92 | 152.07 |
| 065 | 9/20/06 | 2.88 | 4 | 3113 | 26598 | 0.06 | 4.85 | 2.61 | 221.00 | 9.22 | 124.19 |
| 066 | 9/20/06 | 3.97 | 2 | 2942 | 27207 | 0.05 | 5.94 | 3.54 | 280.40 | 18.03 | 158.88 |
| 067 | 9/21/06 | 3.47 | 2 | 2442 | 21042 | 0.07 | 4.73 | 1.78 | 134.70 | 5.87 | 78.60 |
| 068 | 9/21/06 | 2.64 | 2 | 3532 | 32848 | 0.06 | 3.63 | 2.12 | 204.00 | 35.95 | 179.31 |
| 069 | 9/21/06 | 3.47 | 5 | 2916 | 25618 | 0.05 | 3.73 | 2.98 | 206.50 | 23.48 | 114.86 |
| 070 | 9/22/06 | 2.81 | 2 | 2521 | 24411 | 0.06 | 7.28 | 5.61 | 352.70 | 12.68 | 133.62 |
| 071 | 9/22/06 | 3.64 | 2 | 3072 | 27170 | 0.06 | 4.95 | 2.50 | 216.40 | 7.65 | 85.62 |
| 072 | 9/22/06 | 3.48 | 6 | 2935 | 26057 | 0.04 | 4.43 | 2.67 | 207.10 | 7.13 | 75.67 |

Home characteristics and air leakage data.

| Home ID | Date | Home Age | # Occ | Fl Area | Volume | WD Area/ Fl Area | $ACH_{50}$ | SLA | Home to OA ELA | Home to Garage ELA | Garage to OA ELA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 073 | 1/24/07 | 5.06 | 3 | 2857 | 26252 | 0.06 | 4.75 | 2.50 | 200.70 | 4.09 | 80.91 |
| 074 | 1/24/07 | 4.15 | 5 | 2855 | 28356 | 0.07 | 5.27 | 3.17 | 249.40 | NA | NA |
| 075 | 1/25/07 | NA | 6 | 3156 | 37463 | 0.09 | 6.64 | 5.05 | 430.40 | 24.42 | 123.87 |
| 076 | 1/26/07 | 3.24 | 2 | 3754 | 30752 | 0.05 | 4.51 | 2.33 | 237.70 | 18.65 | 129.85 |
| 077 | 1/27/07 | 3.49 | 2 | 3590 | 33599 | 0.08 | 4.20 | 2.38 | 235.70 | 7.02 | 138.55 |
| 078 | 1/30/07 | 4.83 | 3 | 3116 | 26172 | 0.06 | 4.11 | 2.19 | 184.80 | 11.84 | 235.17 |
| 079 | 1/30/07 | 2.08 | 3 | 2180 | 17949 | 0.06 | 4.87 | 2.65 | 154.20 | 16.56 | 290.51 |
| 080 | 1/30/07 | 3.67 | 6 | 3066 | 27626 | 0.07 | 5.14 | 2.82 | 237.90 | 9.85 | 80.59 |
| 081 | 2/1/07 | 2.25 | 3 | 2258 | 18989 | 0.10 | 4.83 | 2.90 | 169.90 | 13.73 | 60.05 |
| 083 | 2/2/07 | 3.34 | 3 | 1864 | 16223 | 0.08 | 6.20 | 3.88 | 187.30 | 1.05 | 61.41 |
| 084 | 2/2/07 | 3.93 | 2 | 2348 | 20537 | 0.07 | 4.67 | 3.01 | 181.20 | 11.95 | 78.71 |
| 085 | 2/2/07 | 4.09 | 4 | 2389 | 21224 | 0.07 | 4.87 | 2.71 | 176.00 | 9.01 | 73.99 |
| 086 | 2/6/07 | 4.27 | 2 | 1879 | 16187 | 0.06 | 5.31 | 3.43 | 164.50 | 13.73 | 126.08 |
| 087 | 2/6/07 | NA | 4 | 1902 | 17392 | 0.07 | 4.36 | 3.28 | 143.90 | 21.38 | 168.52 |
| 088 | 2/6/07 | 4.10 | 1 | 3257 | 26735 | 0.06 | 4.76 | 2.63 | 227.30 | 17.61 | 161.71 |
| 089 | 2/7/07 | 2.35 | 2 | 2828 | 23064 | 0.06 | 5.18 | 2.62 | 202.70 | 24.21 | 74.62 |
| 090 | 2/7/07 | 4.27 | 4 | 1902 | 17439 | 0.07 | 4.25 | 3.01 | 144.40 | 16.24 | 180.47 |
| 091 | 2/7/07 | 4.02 | 5 | 2686 | 21534 | 0.05 | 4.10 | 1.96 | 145.90 | 35.11 | 219.98 |
| 092 | 2/8/07 | 4.27 | 8 | 3327 | 27570 | 0.06 | 4.49 | 2.41 | 215.50 | 27.77 | 174.49 |
| 093 | 2/8/07 | 3.69 | 3 | 2324 | 20276 | 0.08 | 5.12 | 2.99 | 184.70 | 22.32 | 133.31 |
| 094 | 2/9/07 | 4.27 | 2 | 1667 | 12996 | 0.08 | 6.27 | 3.73 | 157.50 | 31.65 | 98.83 |
| 095 | 2/9/07 | 2.86 | 4 | 2790 | 26729 | 0.06 | 4.97 | 3.05 | 229.70 | 22.22 | 119.37 |
| 096 | 2/9/07 | 1.69 | 3 | 3443 | 33276 | 0.06 | 4.72 | 2.84 | 266.80 | 17.50 | 277.51 |
| 097 | 2/21/07 | 5.05 | 2 | 2258 | 21788 | 0.06 | 5.49 | 3.30 | 203.30 | 45.06 | 413.75 |
| 098 | 2/21/07 | 4.14 | 4 | 2205 | 21098 | 0.06 | 5.78 | 3.60 | 213.00 | 23.89 | 379.17 |
| 099 | 2/25/07 | 3.65 | 4 | 3404 | 34194 | 0.06 | 3.52 | 2.03 | 194.40 | 13.62 | 160.55 |
| 101 | 2/23/07 | 3.56 | 2 | 1677 | 16010 | 0.07 | 4.87 | 3.29 | 143.60 | 19.91 | 316.18 |
| 102 | 2/24/07 | 2.48 | 1 | 1940 | 16663 | 0.07 | 4.55 | 2.57 | 133.30 | 13.41 | 91.07 |
| 104 | 2/24/07 | 2.98 | 2 | 1771 | 15158 | 0.08 | 7.32 | 3.73 | 183.20 | 90.34 | 329.70 |
| 105 | 2/28/07 | 3.49 | 5 | 3923 | 34840 | 0.05 | 4.72 | 2.55 | 275.10 | 42.97 | 256.97 |
| 106 | 3/1/07 | 3.33 | 6 | 2301 | 21273 | 0.07 | 4.68 | 2.81 | 173.90 | 6.92 | 192.62 |
| 107 | 3/1/07 | 4.58 | 3 | 2752 | 25399 | 0.06 | 2.83 | 1.77 | 128.80 | 80.80 | 461.86 |

Home characteristics and air leakage data.

| Home ID | Date | Home Age | # Occ | Fl Area | Volume | WD Area/ Fl Area | $ACH_{50}$ | SLA | Home to OA ELA | Home to Garage ELA | Garage to OA ELA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 108 | 3/1/07 | 3.41 | 2 | 2878 | 26961 | 0.08 | 6.05 | 3.68 | 284.90 | 69.90 | 207.30 |
| 109 | 3/3/07 | 3.67 | 2 | 2226 | 21330 | 0.07 | 3.97 | 2.67 | 155.30 | 14.04 | 203.63 |
| 110 | 3/3/07 | 3.17 | 2 | 1616 | 13821 | 0.08 | 5.62 | 3.50 | 145.80 | 11.95 | 125.45 |
| 112 | 3/6/07 | 4.01 | 4 | 4457 | 40371 | 0.04 | 5.61 | 2.66 | 344.70 | 74.62 | 311.26 |
| 113 | 3/6/07 | 4.93 | 5 | 2785 | 27450 | 0.08 | 5.21 | 3.02 | 234.50 | 13.10 | 131.73 |
| 114 | 3/7/07 | 3.68 | 5 | 3451 | 30164 | 0.06 | 6.06 | 3.11 | 299.30 | 6.29 | 225.64 |
| 115 | 3/7/07 | 3.85 | 4 | 2028 | 17462 | 0.07 | 7.11 | 4.01 | 217.80 | 20.75 | 208.66 |
| 116 | 3/7/07 | 4.60 | 4 | 4182 | 40288 | 0.05 | 4.23 | 2.48 | 258.60 | 96.52 | 529.14 |
| 117 | 3/8/07 | 2.43 | 2 | 2319 | 22231 | 0.08 | 5.23 | 3.24 | 202.10 | 3.88 | 219.03 |
| 118 | 3/8/07 | 2.93 | 3 | 1548 | 13296 | 0.07 | 5.18 | 3.14 | 126.70 | 14.67 | 336.31 |
| 119 | 3/8/07 | NA | 1 | 1532 | 13144 | 0.07 | 5.34 | 3.29 | 130.60 | 10.58 | 242.93 |
| 120 | 3/9/07 | 4.02 | 2 | 1361 | 12459 | 0.06 | 5.94 | 3.27 | 123.00 | 96.21 | 618.32 |
| 121 | 3/9/07 | 4.94 | 3 | 2261 | 20499 | 0.04 | 4.41 | 2.89 | 168.90 | 26.10 | 274.89 |

Forced air unit (FAU) duct leakage data.

| Home ID | Date | System #1 Duct Leakage (%) | System #2 Duct Leakage (%) | System #3 Duct Leakage (%) |
|---|---|---|---|---|
| 001 | 8/8/06 | 8.9 | | |
| 002 | 3/4/07 | 6.1 | | |
| 003 | 8/8/06 | 11.3 | | |
| 004 | 8/9/06 | 7.4 | | |
| 005 | 2/28/07 | 15.8 | 16.7 | |
| 006 | 2/28/07 | 7.4 | 13.1 | |
| 008 | 8/10/06 | 4.2 | | |
| 009 | 8/10/06 | 8.0 | | |
| 010 | 8/11/06 | 5.4 | | |
| 011 | 3/3/07 | 7.2 | | |
| 012 | 8/11/06 | 3.8 | | |
| 013 | 8/15/06 | 8.5 | | |
| 014 | 8/15/06 | 9.4 | | |
| 015 | 8/15/06 | 9.2 | | |
| 016 | 8/16/06 | 11.2 | | |
| 017 | 2/22/07 | 4.8 | | |
| 018 | 8/16/06 | 7.5 | | |
| 019 | 8/17/06 | 29.3 | | |
| 020 | 8/17/06 | 13.4 | | |
| 021 | 8/17/06 | 12.5 | | |
| 022 | 8/18/06 | 4.8 | | |
| 023 | 8/18/06 | 9.0 | | |
| 024 | 8/18/06 | 10.2 | | |
| 025 | 8/22/06 | 11.1 | | |
| 026 | 8/22/06 | 12.8 | | |
| 027 | 8/22/06 | 12.6 | | |
| 029 | 8/23/06 | 3.5 | | |
| 030 | 8/23/06 | 27.8 | | |
| 031 | 8/24/06 | 6.8 | | |
| 032 | 8/24/06 | 12.7 | | |
| 033 | 8/27/06 | 8.8 | | |
| 034 | 8/25/06 | 73.5 | 34.0 | 17.2 |
| 037 | 9/6/06 | 8.3 | 9.2 | |
| 038 | 1/24/07 | 4.1 | 4.2 | |
| 039 | 1/24/07 | 9.5 | 3.9 | |
| 040 | 9/7/06 | 11.4 | 6.8 | |
| 041 | 1/28/07 | 9.2 | | |
| 042 | 9/7/06 | 10.5 | | |
| 043 | 9/8/06 | 32.8 | 38.4 | |
| 044 | 9/8/06 | 7.2 | | |
| 045 | 9/8/06 | 14.3 | | |
| 046 | 9/8/06 | 11.3 | 9.7 | |
| 047 | 9/8/06 | 6.0 | | |
| 048 | 9/9/06 | 8.7 | | |
| 049 | 1/31/07 | 16.2 | | |
| 050 | 9/13/06 | 10.4 | 13.0 | |
| 053 | 9/14/06 | 9.3 | 9.7 | |
| 054 | 9/14/06 | 16.9 | 12.8 | |
| 055 | 9/15/06 | 17.1 | | |
| 056 | 9/15/06 | 13.4 | 14.1 | |
| 058 | 2/1/07 | 9.7 | 10.4 | |
| 059 | 9/18/06 | 9.4 | 8.5 | |

Forced air unit (FAU) duct leakage data.

| Home ID | Date | System #1 Duct Leakage (%) | System #2 Duct Leakage (%) | System #3 Duct Leakage (%) |
|---|---|---|---|---|
| 061 | 9/19/06 | 8.9 | | |
| 062 | 9/19/06 | NA | | |
| 064 | 9/20/06 | 14.0 | 8.6 | |
| 065 | 9/20/06 | 11.1 | 6.9 | |
| 066 | 9/20/06 | 7.8 | | |
| 067 | 9/21/06 | 8.8 | 10.4 | |
| 068 | 9/21/06 | 11.6 | 13.0 | |
| 069 | 9/21/06 | 13.2 | | |
| 070 | 9/22/06 | 6.2 | | |
| 071 | 9/22/06 | 20.7 | | |
| 072 | 9/22/06 | 9.2 | | |
| 073 | 1/24/07 | 10.6 | 14.6 | |
| 074 | 1/24/07 | 10.9 | 10.2 | |
| 075 | 1/25/07 | 16.8 | 14.2 | |
| 076 | 1/26/07 | 8.5 | 9.5 | |
| 077 | 1/27/07 | 9.0 | 12.2 | |
| 078 | 1/30/07 | 11.6 | 8.4 | |
| 079 | 1/30/07 | 7.3 | | |
| 080 | 1/30/07 | 10.1 | 10.2 | |
| 081 | 2/1/07 | NA | | |
| 083 | 2/2/07 | 17.0 | | |
| 084 | 2/2/07 | 11.3 | | |
| 085 | 2/2/07 | 14.8 | | |
| 086 | 2/6/07 | 8.8 | | |
| 087 | 2/6/07 | 6.3 | | |
| 088 | 2/6/07 | 10.4 | 7.5 | |
| 089 | 2/7/07 | 16.0 | | |
| 090 | 2/7/07 | NA | | |
| 091 | 2/7/07 | 1.9 | | |
| 092 | 2/8/07 | 9.9 | 6.7 | |
| 093 | 2/8/07 | 11.5 | | |
| 094 | 2/9/07 | 11.8 | | |
| 095 | 2/9/07 | 8.8 | | |
| 096 | 2/9/07 | 7.2 | 7.3 | |
| 097 | 2/21/07 | 4.8 | | |
| 098 | 2/21/07 | 21.8 | | |
| 099 | 2/25/07 | 5.6 | | |
| 101 | 2/23/07 | 6.4 | | |
| 102 | 2/24/07 | 8.9 | | |
| 104 | 2/24/07 | 46.6 | | |
| 105 | 2/28/07 | 10.6 | 14.3 | |
| 106 | 3/1/07 | 14.6 | | |
| 107 | 3/1/07 | 15.8 | | |
| 108 | 3/1/07 | 10.4 | 11.0 | |
| 109 | 3/3/07 | 4.8 | | |
| 110 | 3/3/07 | 5.8 | | |
| 112 | 3/6/07 | 36.7 | | |
| 113 | 3/6/07 | 10.7 | | |
| 114 | 3/7/07 | 5.2 | 7.9 | |
| 115 | 3/7/07 | 10.1 | | |
| 116 | 3/7/07 | 31.9 | | |
| 117 | 3/8/07 | 16.8 | | |

Forced air unit (FAU) duct leakage data.

| Home ID | Date | System #1 Duct Leakage (%) | System #2 Duct Leakage (%) | System #3 Duct Leakage (%) |
|---|---|---|---|---|
| 118 | 3/8/07 | 4.4 | | |
| 119 | 3/8/07 | 5.1 | | |
| 120 | 3/9/07 | 5.7 | | |
| 121 | 3/9/07 | 6.0 | | |

Window usage and mechanical exhaust and outdoor air exchange rate data.

| Home ID | Date | Test Day Window Usage ($ft^2$-hrs) | Week Average Window Usage ($ft^2$-hrs) | Exhaust Air 24-hr Air Exchange Rate | Outdoor Air 24-hr Air Exchange Rate |
|---|---|---|---|---|---|
| 001 | 8/8/06 | 94.57 | 143.89 | 0.01 | na |
| 002 | 8/8/06 | 833.62 | 988.85 | 0.03 | 0.000 |
| 002 | 3/2/07 | 28.85 | 46.98 | 0.02 | 0.000 |
| 003 | 8/8/06 | 299.79 | 153.07 | 0.01 | 0.000 |
| 004 | 3/2/07 | 0.00 | 1.14 | 0.03 | 0.004 |
| 004 | 8/9/06 | 753.54 | 829.51 | 0.03 | 0.010 |
| 005 | 8/9/06 | 0.00 | 0.00 | 0.01 | 0.000 |
| 005 | 2/28/07 | 0.00 | 0.00 | 0.02 | 0.000 |
| 005 | 10/24/06 | 0.00 | 0.00 | 0.01 | 0.000 |
| 006 | 10/24/07 | 527.67 | 506.02 | 0.00 | 0.000 |
| 006 | 8/9/06 | 13.00 | 176.19 | 0.01 | 0.000 |
| 006 | 2/28/07 | 0.00 | 0.37 | 0.01 | 0.000 |
| 008 | 8/10/06 | 91.91 | 186.29 | 0.00 | 0.032 |
| 008 | 3/2/07 | 1.71 | 1.71 | 0.01 | 0.048 |
| 009 | 8/10/06 | 198.76 | 169.99 | 0.03 | 0.070 |
| 010 | 8/11/06 | 42.29 | 71.89 | 0.00 | 0.021 |
| 011 | 3/3/07 | 0.00 | 0.00 | 0.00 | na |
| 011 | 8/11/06 | 0.00 | 0.00 | 0.00 | na |
| 012 | 8/11/06 | 362.40 | 319.56 | 0.00 | 0.002 |
| 013 | 8/15/06 | 45.18 | 42.33 | 0.06 | 0.000 |
| 013 | 10/25/07 | 609.74 | 424.14 | 0.04 | 0.000 |
| 014 | 8/15/06 | 1305.96 | 808.79 | 0.00 | 0.000 |
| 015 | 8/15/06 | 833.24 | 718.86 | 0.00 | 0.408 |
| 016 | 8/16/06 | 497.36 | 341.46 | 0.51 | 0.442 |
| 017 | 8/16/06 | 1113.70 | 925.33 | 0.35 | 0.469 |
| 017 | 2/22/07 | 0.00 | 0.00 | 0.36 | 0.469 |
| 018 | 8/16/06 | 0.00 | 8.20 | 0.00 | 1.816 |
| 018 | 2/22/07 | 0.00 | 0.00 | 0.01 | 0.622 |
| 019 | 2/21/07 | 0.00 | 0.00 | 0.00 | 0.534 |
| 019 | 10/25/06 | 364.27 | 277.03 | 0.00 | 0.013 |
| 019 | 8/17/06 | 2447.54 | 1180.63 | 0.00 | 0.595 |
| 020 | 8/17/06 | 0.00 | 2.79 | 0.00 | 0.000 |
| 021 | 8/17/06 | 0.83 | 3.78 | 0.02 | 0.054 |
| 022 | 8/18/06 | 203.76 | 173.98 | 0.03 | na |
| 023 | 8/18/06 | 34.71 | 33.56 | 0.00 | 0.000 |
| 024 | 8/18/06 | 299.56 | 235.45 | 0.17 | 0.191 |
| 025 | 2/22/07 | 0.00 | 0.00 | 0.16 | 0.224 |
| 025 | 8/22/06 | 118.43 | 95.96 | 0.16 | 2.021 |
| 026 | 8/22/06 | 290.44 | 452.04 | 0.17 | 0.123 |
| 027 | 8/22/06 | 421.27 | 520.33 | 0.01 | 0.000 |
| 029 | 8/23/06 | 104.41 | 464.54 | 0.02 | 0.000 |
| 030 | 8/23/06 | 49.21 | 75.68 | 0.00 | 0.000 |
| 031 | 8/24/06 | 200.60 | 315.46 | 0.00 | 0.000 |
| 032 | 8/24/06 | 530.71 | 411.65 | 0.04 | 0.000 |
| 033 | 8/27/06 | 47.50 | 17.81 | 0.02 | 0.000 |
| 033 | 8/25/06 | 29.69 | 17.81 | 0.02 | 0.000 |
| 033 | 8/26/06 | 47.50 | 17.81 | 0.02 | 0.000 |
| 034 | 8/25/06 | 457.51 | 500.22 | 0.02 | 3.696 |
| 037 | 9/6/06 | 169.01 | 130.87 | 0.00 | 0.000 |
| 038 | 9/6/06 | 58.47 | 12.54 | 0.00 | 0.000 |
| 038 | 1/24/07 | 27.08 | 27.32 | 0.00 | 0.000 |

Window usage and mechanical exhaust and outdoor air exchange rate data.

| Home ID | Date | Test Day Window Usage ($ft^2$-hrs) | Week Average Window Usage ($ft^2$-hrs) | Exhaust Air 24-hr Air Exchange Rate | Outdoor Air 24-hr Air Exchange Rate |
|---|---|---|---|---|---|
| 039 | 1/25/07 | 0.00 | 0.00 | 0.02 | 0.000 |
| 039 | 9/6/06 | 23.44 | 72.24 | 0.01 | 0.000 |
| 040 | 9/7/06 | 303.95 | 453.75 | 0.01 | 0.000 |
| 041 | 1/27/07 | 0.00 | 9.59 | 0.00 | 0.000 |
| 041 | 1/26/07 | 5.39 | 9.59 | 0.00 | 0.000 |
| 041 | 1/28/07 | 0.81 | 9.59 | 0.00 | 0.000 |
| 041 | 9/7/06 | 38.96 | 59.21 | 0.02 | 0.000 |
| 042 | 9/7/06 | 132.10 | 122.06 | 0.01 | 0.000 |
| 043 | 9/8/06 | 298.26 | 242.44 | 0.00 | 0.012 |
| 044 | 9/8/06 | 301.41 | 351.76 | 0.01 | 2.182 |
| 044 | 1/27/07 | 0.55 | 3.06 | 0.00 | 0.000 |
| 045 | 1/24/07 | 0.00 | 4.02 | 0.00 | 0.000 |
| 045 | 9/8/06 | 1.04 | 2.07 | 0.02 | 0.000 |
| 046 | 9/9/06 | 61.11 | 21.01 | 0.00 | 0.000 |
| 047 | 9/9/06 | 0.00 | 0.32 | 0.02 | 0.000 |
| 048 | 9/9/06 | 415.70 | 151.32 | 0.01 | 0.000 |
| 049 | 1/31/07 | 0.00 | 25.80 | 0.00 | 0.000 |
| 049 | 9/13/06 | 67.22 | 320.16 | 0.00 | 0.000 |
| 050 | 1/31/07 | 0.00 | 0.04 | 0.00 | 0.000 |
| 050 | 9/13/06 | 937.65 | 521.17 | 0.01 | 0.000 |
| 053 | 9/14/06 | 1216.58 | 1260.36 | 0.01 | 0.000 |
| 054 | 9/14/06 | 785.13 | 837.38 | 0.01 | 0.000 |
| 055 | 9/15/06 | 335.42 | 265.60 | 0.10 | 0.000 |
| 056 | 9/15/06 | 770.76 | 740.41 | 0.00 | 0.000 |
| 058 | 9/16/06 | 1267.94 | 1049.77 | 0.00 | 0.000 |
| 058 | 2/1/07 | 0.00 | 3.14 | 0.01 | 0.008 |
| 059 | 9/16/06 | 999.14 | 1099.41 | 0.01 | 0.000 |
| 059 | 9/17/06 | 1260.87 | 1099.41 | 0.00 | 0.000 |
| 059 | 9/18/06 | 1158.90 | 1099.41 | 0.01 | 0.000 |
| 059 | 1/30/07 | 103.35 | 88.26 | 0.00 | 0.000 |
| 061 | 9/19/06 | 0.00 | 157.32 | 0.00 | 0.000 |
| 062 | 9/19/06 | 353.84 | 359.42 | 0.00 | 0.000 |
| 062 | 1/26/07 | 263.77 | 102.44 | 0.02 | 0.000 |
| 064 | 9/20/06 | 263.46 | 337.52 | 0.00 | 0.000 |
| 065 | 9/20/06 | 622.58 | 620.05 | 0.03 | 0.000 |
| 066 | 9/20/06 | 0.00 | 33.66 | 0.00 | 0.000 |
| 067 | 9/21/06 | 1258.77 | 648.13 | 0.00 | 0.000 |
| 068 | 9/21/06 | 179.77 | 186.06 | 0.00 | 0.000 |
| 069 | 9/21/06 | 112.67 | 309.52 | 0.00 | 0.000 |
| 070 | 9/22/06 | 98.39 | 169.34 | 0.00 | 0.000 |
| 071 | 9/22/06 | 313.17 | 247.99 | 0.01 | 0.000 |
| 072 | 9/22/06 | 392.62 | 220.73 | 0.00 | 0.000 |
| 073 | 1/24/07 | 23.49 | 16.00 | 0.00 | 0.000 |
| 074 | 1/24/07 | 0.64 | 0.40 | 0.01 | 0.000 |
| 075 | 1/25/07 | 22.52 | 3.22 | 0.00 | 0.000 |
| 076 | 1/26/07 | 92.36 | 109.90 | 0.01 | 0.000 |
| 077 | 1/27/07 | 0.00 | 10.89 | 0.00 | 0.000 |
| 078 | 1/30/07 | 83.37 | 144.69 | 0.01 | 0.000 |
| 079 | 1/30/07 | 44.35 | 24.60 | 0.04 | 0.000 |
| 080 | 1/30/07 | 0.00 | 186.70 | 0.01 | 0.000 |
| 081 | 2/1/07 | 21.17 | 49.82 | 0.02 | 0.000 |

Window usage and mechanical exhaust and outdoor air exchange rate data.

| Home ID | Date | Test Day Window Usage ($ft^2$-hrs) | Week Average Window Usage ($ft^2$-hrs) | Exhaust Air 24-hr Air Exchange Rate | Outdoor Air 24-hr Air Exchange Rate |
|---|---|---|---|---|---|
| 083 | 2/2/07 | 13.77 | 30.43 | 0.03 | 0.083 |
| 084 | 2/2/07 | 0.00 | 0.00 | 0.00 | 0.000 |
| 085 | 2/2/07 | 5.28 | 14.10 | 0.02 | 0.000 |
| 086 | 2/6/07 | 1.92 | 6.79 | 0.00 | 0.000 |
| 087 | 2/6/07 | 320.57 | 110.27 | 0.02 | 0.000 |
| 088 | 2/6/07 | 32.99 | 8.20 | 0.00 | 0.000 |
| 089 | 2/7/07 | 512.19 | 248.23 | 0.01 | 0.000 |
| 090 | 2/7/07 | 169.13 | 87.13 | 0.00 | 0.000 |
| 091 | 2/7/07 | 72.48 | 43.30 | 0.02 | 0.000 |
| 092 | 2/8/07 | 0.00 | 1.11 | 0.01 | 0.000 |
| 093 | 2/8/07 | 0.00 | 0.00 | 0.00 | 0.000 |
| 094 | 2/9/07 | 31.73 | 251.24 | 0.00 | 0.000 |
| 095 | 2/9/07 | 0.00 | 86.97 | 0.03 | 0.000 |
| 096 | 2/9/07 | 0.00 | 5.13 | 0.01 | 0.000 |
| 097 | 2/21/07 | 0.00 | 0.00 | 0.53 | 0.333 |
| 098 | 2/21/07 | 0.00 | 0.00 | 0.00 | 0.000 |
| 099 | 2/23/07 | 0.00 | 0.00 | 0.01 | 0.013 |
| 099 | 2/25/07 | 0.00 | 0.00 | 0.01 | 0.013 |
| 099 | 2/24/07 | 0.00 | 0.00 | 0.00 | 0.013 |
| 101 | 2/23/07 | 0.00 | 0.00 | 0.00 | 0.000 |
| 102 | 2/24/07 | 0.00 | 0.00 | 0.00 | 0.029 |
| 104 | 2/24/07 | 0.00 | 0.00 | 0.31 | 0.259 |
| 105 | 2/28/07 | 0.00 | 1.15 | 0.00 | 0.000 |
| 106 | 3/1/07 | 0.00 | 0.00 | 0.02 | 0.000 |
| 107 | 3/1/07 | 13.01 | 9.45 | 0.00 | 0.000 |
| 108 | 3/1/07 | 4.34 | 1.62 | 0.04 | 0.000 |
| 109 | 3/3/07 | 0.00 | 0.00 | 0.11 | 0.002 |
| 110 | 3/3/07 | 140.15 | 67.91 | 0.08 | 0.002 |
| 112 | 3/6/07 | 324.71 | 154.74 | 0.01 | 0.000 |
| 113 | 3/6/07 | 0.00 | 101.42 | 0.04 | 0.000 |
| 114 | 3/7/07 | 0.00 | 0.00 | 0.02 | 0.000 |
| 115 | 3/7/07 | 20.26 | 53.19 | 0.01 | 0.000 |
| 116 | 3/7/07 | 50.49 | 58.01 | 0.02 | 0.000 |
| 117 | 3/8/07 | 0.00 | 0.00 | 0.00 | 0.000 |
| 118 | 3/8/07 | 0.00 | 53.07 | 0.01 | 0.000 |
| 119 | 3/8/07 | 0.00 | 36.85 | 0.00 | na |
| 120 | 3/9/07 | 0.00 | 55.86 | 0.02 | 0.000 |
| 121 | 3/9/07 | 159.84 | 121.24 | 0.01 | 0.000 |

Mechanical outdoor air ventilation system characteristics.

| Home ID | System Type | Damper Type | Control Location | System Operational Status |
|---|---|---|---|---|
| 001 | DOA | ad | fc/attic | not operational |
| 004 | DOA | md | t-stat/home | operational |
| 008 | DOA | md | t-stat/home | operational |
| 009 | DOA | md | t-stat/home | operational |
| 010 | DOA | md | t-stat/home | operational |
| 011 | DOA | md | t-stat/home | not operational |
| 012 | DOA | md | t-stat/home | operational |
| 015 | WHF | gd | switch/home | operational |
| 016 | HRV | na | switch/attic | operational |
| 017 | HRV | na | switch/attic | operational |
| 018 | HRV | na | switch/attic | operational |
| 018 | RAD | ad | t-stat/home | operational |
| 019 | RAD | ad | t-stat/home | operational |
| 021 | DOA | ad | fc/attic | operational |
| 022 | HRV | na | switch/home | not operated |
| 024 | HRV | na | timer/home | operational |
| 024 | WHF | gd | switch/home | operational |
| 025 | HRV | na | switch/attic | operational |
| 025 | RAD | ad | t-stat/home | operational |
| 026 | HRV | na | switch/home | operational |
| 034 | WHF | gd | switch/home | operational |
| 043 | DOA (FAU1) | ad | t-stat/home | operational |
| 043 | DOA (FAU2) | ad | t-stat/home | operational |
| 044 | WD fan | na | switch/home | operational |
| 044 | WHF | gd | switch/home | operational |
| 058 | DOA (FAU1) | md | t-stat/home | operational |
| 070 | EC | ad | t-stat/home | operational |
| 083 | DOA | md | t-stat/home | operational |
| 088 | WHF | gd | switch/home | operational |
| 097 | HRV | na | switch/attic | operational |
| 099 | DOA | ad | fc/attic | operational |
| 102 | DOA | ad | fc/attic | operational |
| 104 | HRV | na | timer/home | operational |
| 109 | DOA | md | t-stat/home | operational |
| 110 | DOA | md | t-stat/home | operational |
| 112 | RAD | ad | t-stat/home | operational |
| 116 | RAD | ad | t-stat/home | operational |
| 117 | RAD | ad | fc t-stat/home | operational |
| 118 | DOA | md | fc/attic | operational |
| 119 | DOA | md | fc/attic | not operational |

Mechanical outdoor air ventilation system outdoor air flow rates and operational on-times during the 24-hour Test Day.

| Home ID | Date | System Type | Outdoor Air Flow Rate (cfm) | Test Day On-time (hours) |
|---|---|---|---|---|
| 1 | 8/8/06 | DOA | na | na |
| 4 | 3/2/07 | DOA | 28 | 1.22 |
| 4 | 8/9/06 | DOA | 28 | 2.81 |
| 8 | 3/2/07 | DOA | 71 | 2.98 |
| 8 | 8/10/06 | DOA | 71 | 1.95 |
| 9 | 8/10/06 | DOA | 48 | 6.20 |
| 10 | 8/11/06 | DOA | 27 | 5.63 |
| 11 | 3/3/07 | DOA | na | na |
| 11 | 8/11/06 | DOA | na | na |
| 12 | 8/11/06 | DOA | 31 | 0.38 |
| 15 | 8/15/06 | WHF | 6591 | 0.68 |
| 16 | 8/16/06 | HRV | 159 | 24.00 |
| 17 | 2/22/07 | HRV | 153 | 24.00 |
| 17 | 8/16/06 | HRV | 153 | 24.00 |
| 18 | 8/16/06 | RAD | 700 | 12.81 |
| 18 | 2/22/07 | RAD | 635 | 1.85 |
| 18 | 2/22/07 | HRV | 120 | 24.00 |
| 18 | 8/16/06 | HRV | 120 | 24.00 |
| 19 | 2/21/07 | RAD | 880 | 0.00 |
| 19 | 8/17/06 | RAD | 880 | 10.52 |
| 19 | 10/25/06 | RAD | 880 | 0.24 |
| 21 | 8/17/06 | DOA | 44 | 9.68 |
| 22 | 8/18/06 | HRV | 209 | na |
| 24 | 8/18/06 | WHF | 5067 | 0.00 |
| 24 | 8/18/06 | WHF | 7486 | 0.00 |
| 24 | 8/18/06 | HRV | 135 | 15.52 |
| 25 | 2/22/07 | RAD | 830 | 0.00 |
| 25 | 2/22/07 | HRV | 90 | 24.00 |
| 25 | 8/22/06 | HRV | 90 | 24.00 |
| 25 | 8/22/06 | RAD | 1110 | 15.63 |
| 26 | 8/22/06 | HRV | 149 | 7.75 |
| 34 | 8/25/06 | WHF | 7272 | 11.31 |
| 43 | 9/8/06 | DOA (2) | 27 | 4.45 |
| 43 | 9/8/06 | DOA (1) | 8 | 1.61 |
| 44 | 1/27/07 | WDF | 201 | 0.00 |
| 44 | 1/27/07 | WHF | 3856 | 0.00 |

Mechanical outdoor air ventilation system outdoor air flow rates and operational on-times during the 24-hour Test Day.

| Home ID | Date | System Type | Outdoor Air Flow Rate (cfm) | Test Day On-time (hours) |
|---|---|---|---|---|
| 44 | 9/8/06 | WDF | 201 | 18.50 |
| 44 | 9/8/06 | WHF | 3856 | 4.83 |
| 58 | 2/1/07 | DOA | 49 | 2.19 |
| 58 | 9/15/06 | DOA | 49 | 0.00 |
| 70 | 9/22/06 | EC | 2450 | 0.00 |
| 83 | 2/2/07 | DOA | 355 | 1.51 |
| 88 | 2/6/07 | WHF | 3589 | 0.00 |
| 88 | 2/6/07 | WHF | 3250 | 0.00 |
| 97 | 2/21/07 | HRV | 121 | 24.00 |
| 99 | 2/24/07 | DOA | 10 | 17.94 |
| 99 | 2/25/07 | DOA | 10 | 17.91 |
| 99 | 2/23/07 | DOA | 10 | 17.78 |
| 102 | 2/24/07 | DOA | 9 | 1.63 |
| 104 | 2/24/07 | HRV | 66 | 23.75 |
| 109 | 3/3/07 | DOA | 52 | 0.38 |
| 110 | 3/3/07 | DOA | 63 | 0.14 |
| 112 | 3/6/07 | RAD | 1175 | 0.00 |
| 116 | 3/7/07 | RAD | 945 | 0.00 |
| 117 | 3/8/07 | RAD | 775 | 0.00 |
| 118 | 3/8/07 | DOA | 31 | 3.69 |
| 119 | 3/8/07 | DOA | na | na |

# APPENDIX G

## Difficulties Encountered in the Field Study

The following are difficulties that we encountered during the study, followed by the corrective action that was taken. Unless otherwise noted, we have deleted from the database and the associated data analyses the data noted below that was unable to be collected as a result of constraints encountered in the field or were associated with shortened sample periods (thus not representative of the standard 24-hour samples), failed analytical analyses, or yielded unrealistic data.

1. During the Summer-North field session, three formaldehyde/acetaldehyde samples, 001-F1-080706, 005-F2-080806, and 012-F1-081006 had fallen off from the air sampling rig. To ensure that the samples did not fall off in the future, an extra one-inch piece of Masterflex Norprene tubing was added to the top of the charcoal scrubber to secure the samples.

2. During the Winter-South field session, there were two pump failures that occurred in homes that affected the formaldehyde/acetaldehyde sample 045-F1-012307 and 079-F1-012907 and VOC samples 045-V1-012307 and 079-V1-012907. Team 3 found the pumps off upon arrival but were able to recover the elapsed time. It was unknown what had caused the pump malfunctions, but to ensure that samples were not shortened in the future we minimized the use of these pumps.

3. During the analyses of the formaldehyde/acetaldehyde measurements, 084-F2-020107 and 086-F1D-020507, a laboratory error occurred and the analyses for these two samples were lost.

4. For the formaldehyde/acetaldehyde measurements in the FAU in Home 033 during the Summer-North field session, all three samples, 033-FSA-082406 (supply air sample), 033-FRA-082406 (return air sample), and 033-FAA-082406 (attic) suffered a sampling error. The field technician inadvertently installed the Anasorb CSC, coconut charcoal sorbent tube in front of the DNPH sampler. This scrubber was supposed to be placed downstream of the sampler to scrub the emissions of residual acetonitrile released by the DNPH sample cartridge. The net result of this was that the formaldehyde and acetaldehyde mass concentrations were either below the method mass detection limit or unrealistically low.

5. For the $PM_{2.5}$ samples there was one sample lost. Sample 018-P1-022107, yielded an unrealistically low mass gain of -1 µg indoor concentration. An examination of the air sample flow rates indicated proper air sampling rates. Re-weighing the filter resulted in confirmation of the laboratory post-sampling weighing. Thus, the cause of this sample error is either that the filter was not installed into the air sampler or there was an error associated with the pre-sampling weighing. We examined with a microscope at 100x filter 018-P1-022107, filters with normal mass loadings, and field blanks, and could not

discern any visible difference. We thus cannot say one way or another whether the filter 018-P1-022107 was ever installed.

6. For the PFT samplers there were two samples lost. Sample 099-T1-022207 was lost during the laboratory analyses. Sample 019-T1-081606 yielded an unrealistically low outdoor air exchange rate, 0.03 ach.

7. There was a malfunction with IAQ Calc #1, where Team 3 had found it off on two occasions—one in Winter North Home 108 and Winter South Home 039. It was unknown what had caused the malfunction, but to ensure that samples were not shortened in the future we minimized the use of IAQ Calc #1 in the future, resulting in no further failures. Both homes had samples sets representing more than 63% of the 24-hour sampling period (i.e., Home 039 with 63% of 24 hours from 16:16 to 07:30 and Home 108 data with 84% of 24 hours from 16:08 to 12:24), thus we elected to retain these data (i.e., CO, $CO_2$, T, and RH) in both the database and the associated population statistics.

8. We also observed that IAQ Calc #6 had a malfunction when recording temperature and relative humidity. The results were observed to be erratic and unrealistic at four homes (019-C1D-022007, 077-C1-020507, 107-C2D-022807, and 117-C1-030707) in the Winter-North field session and two homes (084-C1-020107 and 086-C1-020507) in the Winter-South field session. To reduce any future problems, the use of IAQ Calc #6 was reduced as much as possible.

9. During the QA/QC review of the carbon monoxide data we discovered three homes with erratic indoor data. The homes were Home 059 (Summer-South), Home 081 (Winter-South), and Home 114 (Winter-North). The cause of these erratic results could not be determined.

10. During the Summer and Winter South Regions, Team 1 did not specify which type of PFT sources had been used, for homes 037, 039, 041 for the summer and 041 for the winter. It was assumed that the A type sources were used when entering data and doing the analyses. We note that the small difference between these two sources is 12 nanoliters per hour (nL/h). For the A source the emission rate is 1584 nL/h and for the X source, the emission rate is 1572 nL/h. As this error is very low (i.e., a 0.76% difference) we elected to retain these data for the population statistics.

11. The building envelope and garage-home air leakage measurements were not performed in Home 043, as a result of insufficient time provided by the homeowner to complete these tests, which represents the last set of tests conducted at each home. Additionally in Home 011, wind conditions allowed only for a CFM50 measurement, and thus only an ACH 50 is calculated and no SLA is calculated, and just a house-to-garage pressure and coupling factor is calculated and no house-to-garage leakage area is calculated.

12. The FAU duct air leakage measurements were not performed in Homes 061, 081, and 090, as a result of the inspectors not being able to seal one or more supply air diffusers in

bedrooms where access was not possible at the time of our inspection (e.g., sleeping occupant).

13. During the Winter South Field Session, Team 1 had distributed the window/door and fan logs using a different adhesive on the back of the logs. When Team 3 arrived to remove the logs, they could not do so without ripping the log sheets. To ensure that the data was not lost, Team 3 copied the information from the logs onto a separate sheet of paper. To prevent this from happening in the future, Team 1 was notified of the adhesive problem and was directed to use the original selected non-residue adhesive.

14. In Home 043 the research team was unable to collect information regarding the area of different types of floor finishes, the area of moisture staining or fungal growth, and the area of composite wood from floors, walls, ceiling, and furniture/cabinetry due to a lack of time provided by the homeowner to complete this task.

The following paragraphs summarize the number and percentage of air contaminant and outdoor air exchange rate samples lost during this study and as described above.

Formaldehyde. A total of 10 of the 221 field samples (4%) were lost, representing a 4% loss percentage. The most common cause of these losses were failures in the sample pumps and tubing connections.

Volatile Organic Compounds. A total of 2 of the 208 field samples were lost, representing a loss percentage of less than 1%. The most common cause of these losses was failure in the sample pumps.

Carbon Monoxide. A total of 3 of the 206 field samples were lost, representing a loss percentage of less than 2%. The cause of these failures is unknown but some type of failure in the electrochemical sensor electronics is suspected.

Outdoor Air Exchange Rate PFT Samples. A total of 2 of the 167 field samples were lost, representing a loss percentage of 1%. The most common cause of these losses was laboratory analytical error.